



In re Patent Application of

Stephen Roland Day

Application No.: 10/520,788

Filed: January 11, 2005

For: LAMINATED GLAZING PANEL

) **MAIL STOP**
) **APPEAL BRIEF - PATENTS**
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) Group Art Unit: 3742
)
) Examiner: STEPHEN J RALIS
)
) Appeal No.: _____
)

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This appeal is from the decision of the Primary Examiner dated August 20, 2008 finally rejecting Claims 1-18 and 20-32, which are reproduced as the Claims Appendix of this brief.

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The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800.

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I. Real Party in Interest

The present application is assigned to Pilkington plc. Pilkington plc is the real party in interest, and is the assignee of Application No. 10/520,788.

II. Related Appeals and Interferences

The Appellant, legal representative and assignee do not know of any other appeal(s) or interference(s) which will affect or be directly affected by, or have bearing on the Board's decision in this pending appeal.

III. Status of Claims

This application was originally filed with a Preliminary Amendment presenting Claims 1-20 for consideration. During prosecution, Claims 21-32 were added and Claim 19 was canceled. Claims 1-18 and 20-32 are currently pending, and Claim 19 is canceled.

Claims 1-18 and 20-32 stand finally rejected. Claims 1-18 and 20-32 are being appealed.

IV. Status of Amendments

Following the Final Official Action issued on August 20, 2008 in this application, a single Amendment was filed on November 20, 2008. The Advisory Action issued on December 16, 2008 states that the November 20, 2008 Amendment will be entered upon the filing of an Appeal.

V. Summary of Claimed Subject Matter

A. The Invention

The subject matter of this application pertains to a laminated glazing panel and a method of manufacturing a laminated glazing panel. The disclosed laminated glazing panel has useful application as a vehicle window.

Laminated glazing panels typically include at least two glass plies and a plastic ply or interlayer laminated between the two glass plies. The background portion of the present application points out that laminated glazing panels are produced in a lamination process involving subjecting the composite glass plies and plastic interlayer to relatively high temperatures and pressures -- temperatures exceeding 100°C and pressures exceeding 5 atmospheres.

The invention here is based at least in part on the recognition that it is desirable and advantageous to provide laminated glazing panels with devices imparting greater utility and usefulness to the laminated glazing panel. The inventors here were interested in providing a laminated glazing panel with light emitting diodes (LEDs) so that additional benefits and operability could be realized.

However, as the background portion of the application discusses, individuals knowledgeable in the area of laminated glazing panels and the manufacture of laminated glazing panels believed it was not possible to laminate one or more circuit board-mounted LEDs in a laminated glazing panel. The reasons are several. First, it was known that the temperature and pressure conditions to which the glass plies and the plastic interlayer are subjected during the lamination process are quite harsh and significantly exceed the relevant ratings for the LEDs. These ratings, for example a temperature rating, are typically set forth in the specification sheets associated with the LEDs and indicate the maximum temperature the LED can withstand. In addition, the LED's in use would be mounted on a circuit board, and the pathways of the circuits provide another possible failure mechanism at high temperatures and pressures. As discussed in lines 16-22 on page two of the present application, the boiling of stray moisture, the expansion of air/gas pockets, and the mismatch between thermal expansion coefficients can result in damage to the LED or detachment of the electrical connection.

Notwithstanding the understanding in the art that it would not be possible to produce an LED-containing laminated glazing panel, the inventors here identified a number of reasons for proceeding in a direction contrary to this accepted wisdom. Some of these reasons are discussed in the last paragraph on page two of the present application

LEDs may be used as indicating devices and may produce relatively intense light at a variety of wavelengths. Intensity of light can be important, for example, when the panel is used as a window and the indicating device needs to be visible against external illumination. Moreover, LEDs have long lifetimes which are comparable to the expected lifetimes of a laminated glazing panel. Furthermore, laminating LED devices, especially those having multiple LEDs mounted on the circuit board, removes the requirement for multiple electrical connections to each LED that would otherwise prevail; rather a single electrical connection to the circuit board itself, via a suitable connection means, is all that is required to power the LEDs.

The inventors here thus proceeded with attempts to produce a laminated glazing panel in which one or more LEDs are laminated between the two glass plies. The discussions in the third paragraph on page two of the application and at the top half of page three of the application point out that the inventors here discovered, quite surprisingly, that it was possible to laminate one or more circuit board-mounted LEDs and a plastic ply between two glass plies and produce a laminated glazing panel in which the LEDs are operable and functional. The inventors are unable to explain how the LEDs are able to withstand the lamination conditions that conventional wisdom believed would render them inoperable or damage them to an extent rendering them unacceptable for use in a laminated glazing panel.

B. Mapping the Independent Claims to the Disclosure

The claims in this application include four independent claims -- Claims 1 and 30 reciting a laminated glazing panel, and Claims 15 and 16 reciting a process for producing a laminated glazing panel. The discussion below maps each of the independent claims to the disclosure in the application and the illustrations in the drawing figures. The following parenthetical references to line numbers and pages refer to the application as filed.

With respect to Claim 1, a laminated glazing panel comprises two glass plies 5, 6 (see page 6, lines 21-24 and Fig. 1), a plastic ply 7 (see page 6, lines 23-24 and Fig. 1) and one or more light emitting diodes 2 (see page 6, lines 21-23 and Fig. 1). The plastic ply 7 and the one or more light emitting diodes 2 are laminated between the two glass plies 5, 6 (see page 6, lines 21-24 and Fig. 1). The one or more light

emitting diodes 2 are mounted on a circuit board 3 (see page 6, lines 21-24 and Fig. 1). The glass plies 5, 6 and the plastic ply 7 with the one or more light emitting diodes are laminated at a temperature of about 100°C to 150°C (see page 6, lines 25-27).

Concerning Claim 15, a process for producing a laminated glazing panel comprises interleaving a plastic ply 7 between two glass plies 5, 6 and laminating the plies (see page 5, lines 16-18 and page 7, line 20-page 8, line 4). Prior to lamination, a cut-out area is prepared in the plastic ply 7 to receive a circuit board 3 on which one or more light emitting diodes 2 are mounted (see page 5, lines 18-19 and page 7, line 20 thru page 8, line 4; and Fig. 1). The circuit board 3 and one or more light emitting diodes 2 are together at least partially coated with a material compatible with the material of the plastic ply (see page 5, lines 19-21 and page 7, lines 22-24). The circuit board 3 is positioned in the cut-out area in the plastic ply 7 (see page 5, lines 21-22, page 7, lines 22-24 and page 7, lines 30-31; and Fig. 1). The laminating of the two glass plies and the plastic ply with the circuit board on which is mounted the one or more light emitting diodes is performed at a temperature of about 100°C to 150°C (see page 6, lines 25-27).

Addressing Claim 16, a process for producing a laminated glazing panel comprises pairing together two plastic plies 7 (see page 5, lines 23-24 and page 7, lines 27-28), and preparing a cut-out area in the upper plastic ply 7 to receive a circuit board 3 on which one or more light emitting diodes are mounted 2 (see page 5, lines 24-26 and page 7, lines 29-30). The circuit board 3 is positioned in the cut-out area (see page 5, line 26 and page 7, lines 30-31), and a further plastic ply 7 is joined to the paired plastic plies, thereby creating a composite ply (see page 5, lines 26-27 and page 7, line 31 thru page 8, line 1). The composite ply is interleaved between two glass plies 5, 6 (see page 5, lines 27-28 and page 7, line 28 thru page 8, line 2). The two glass plies 5, 6 and the composite ply are laminated, including the circuit board 3 on which is mounted the one or more light emitting diodes 2, at a temperature of about 100°C to 150°C (see page 5, line 28, page 8, lines 2-4).

Regarding independent Claim 30, a laminated glazing panel comprising two glass plies 5, 6 (see page 6, lines 21-24 and Fig. 1), a plastic ply 7 (see page 6, lines 23-24 and Fig. 1), and a light emitting diode device 2 (see page 6, lines 21-23 and

Fig. 1) laminated between the glass plies 5, 6. The light emitting diode device which is laminated between the glass plies 5, 6 comprises one or more light emitting diodes mounted on a circuit board 3 (see page 6, lines 21-24 and Fig. 1). The glass plies and the plastic ply with the one or more light emitting diodes are laminated at a temperature of about 100°C to 150°C (see page 6, lines 25-27). The laminated glazing panel possesses a thickness of 8 mm or less (see page 5, lines 13-15), and the light emitting diode device possesses a thickness less than 0.8 mm (see page 5, lines 9-13).

VI. Grounds of Rejection to be Reviewed on Appeal

A. The rejection of Claims 1, 2, 9-11, 13, 14 16, 19, 21, 23, 24 26, 27, 29, 30, 32 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 3,317,906 to Baldrige (hereinafter Baldrige) in view of U.S. Patent No. 5,193,895 to Naruke et al. (hereinafter Naruke).

B. The rejection of Claims 8, 12, 15, 17 ,18, 22, 25 and 28 under 35 U.S.C. § 103(a) as being unpatentable over Baldrige and Naruke, and further in view of U.S. Patent No. 4,968,895 to Leclercq (hereinafter Leclercq).

C. The rejection of Claim 31 under 35 USC § 103(a) as being unpatentable over Baldrige in view of Naruke, and further in view of U.S. Patent No. 4,761,720 to Solow (hereinafter Solow).

VII. The Applied References

A. Baldrige

Baldrige discloses a windshield laminate 10 provided with instrument indicator devices. The windshield 10 includes a transparent plastic interlayer interposed between a pair of glass panels. The instrument indicator devices in the windshield can take the form of signal lights 12a, 12b, oil and generator signal lights 14, 16, or a speed indicating device 18.

B. Naruke

Naruke discloses a warning light secured to the side face C of a vehicle door B to notify drivers in following vehicles that the vehicle door B is open. The warning light includes, as illustrated in Fig. 18 of Naruke, several light emitting elements 5 mounted on a flexible printed circuit board 6. The flexible printed circuit board 6 is covered with a light-transmissive elastic sheet 5. The purpose of the light-transmissive elastic sheet 55 is to protect the light emitting elements 5 from water. This is discussed in connection with the earlier embodiments of the warning light described in Naruke (see column 3, lines 20-25).

C. Leclercq

Leclercq describes a laminated glass in which a plastic interlayer 5 is positioned between two glass layers 6, 6. In addition, a photodiode is embedded in the plastic interlayer. The photodiode serves as a photosensitive element which measures ambient light for purposes of controlling the turning on and off of the vehicle lights. The photodiode includes a strip of photosensitive material 1. One of the faces 2 of the photosensitive strip serves as the photosensitive element.

D Solow

Solow describes an illuminated tape used as decorative lighting, for example a string of Christmas lights. The illuminated tape includes a plastic strip 10 in which are embedded thin wires 12, 14. A plurality of LEDs 16 are embedded in the plastic between the wires 12, 14. Solow describes that the electrical elements are completely embedded in the plastic so that the illuminated tape is waterproof.

VIII. Argument

A. *The rejection of Claims 1, 2, 9-11, 13, 14 16, 21, 23, 24, 26, 27, 29, 30, 32 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 3,317,906 to Baldrige (hereinafter Baldrige) in view of U.S. Patent No. 5,193,895 to Naruke et al. (hereinafter Naruke).*

Independent Claim 1 and Dependent Claims 2, 10, 11 and 13

The invention recited in independent Claim 1 involves a laminated glazing panel. The claimed laminated glazing panel comprises two glass plies, a plastic ply, and one or more light emitting diodes laminated between the glass plies. The one or more light emitting diodes are mounted on a circuit board. In addition, the glass plies and the plastic ply with the one or more light emitting diodes are laminated at a temperature of about 100°C to 150°C.

Baldrige describes a windshield 10 in which a transparent plastic interlayer is positioned between a pair of glass panels. In addition, an instrument indicator devices is mounted within the laminate. Baldrige states that the instrument indicator devices can be signal lights 12a, 12b, oil and generator signal lights 14, 16 or a speed indicating device 18.

The Examiner correctly observes that Baldrige does not disclose one or more light emitting diodes mounted on a circuit board and laminated between the two glass plies as set forth in Claim 1. The Examiner thus looks beyond the Baldrige disclosure and notes the discussion in Naruke describing the use of light emitting elements 5. From this, the Examiner concludes it would have been obvious to remove the indicator lights of Baldrige and replace them with Naruke's light emitting diodes. The facts here do not support that conclusion of obviousness.

Naruke describes a vehicle door warning light. Naruke is specifically concerned about potential problems that arise when a first vehicle, positioned in front of a second vehicle, has one of its doors open. In that situation, the driver of the following second vehicle may not see the open door.

The background portion of Naruke describes known vehicle door warning lights such as illustrated in Fig. 1. Vehicle door warning lights serve the useful purpose of alerting vehicles behind that the vehicle door is open. Thus, when the vehicle door is closed, the vehicle door warning lights are not visible. On the other hand, when the vehicle door is open, the vehicle door warning lights are quite visible and thus signal to the following vehicles that the door is open. Naruke points out that known vehicle door warning lights require formation of a hole in the side face of the vehicle door to mount the relatively large light body 63. Additionally, the reference

observes that the light body 63 occupies space inside the door and thus presents an obstruction to other vehicular equipment such as a power window driver mechanism.

To address these problems, Naruke proposes a vehicle door warning device that is reduced in size and does not require formation of a hole in the vehicle door. Naruke proposes a vehicle door warning device in which a plurality of light emitting elements 5 are mounted on one side of a circuit board 6 to form a strip-shaped vehicle door warning device. The opposite side of the circuit board 6 is provided with double-sided adhesive tape 11 allowing the vehicle door warning device to be easily mounted on the side face of the vehicle door in a manner conforming to the shape of the side face.

That Naruke describes a strip-mounted light emitting diode warning device applied to the side face of a vehicle to indicate the door is open is in no way a disclosure that an ordinarily skilled artisan would apply to a laminated glazing panel. The disclosure in Naruke has absolutely no relevance to laminated glazing panels such as the windshield disclosed in Baldridge or the laminated glazing panel recited in independent Claim 1. Indeed, the focus of the disclosure in Naruke is simply providing a strip-shaped arrangement of light emitting elements to be mounted on the side face of a vehicle door using a double-sided adhesive. As discussed in column 1, lines 35-60 of the Naruke, and the paragraph bridging columns 5 and 6, Naruke seeks ease of use and detachability in what is apparently an after-market product.

The invention recited in Claim 1 does not involve an adhesive mounted strip-shaped arrangement of light emitting elements. It thus cannot be said that the claimed invention here somehow represents a result that would be predictable from substituting Naruke's door-mounted strip-shaped arrangement of light emitting elements for Baldridge's indicator instruments. Indeed, the claimed invention here does not recite light emitting elements arranged in strip form and adhesively mounted on the surface of the window. Also, a person seeking to improve upon the construction of a windshield as disclosed in Baldridge would not look to vehicle door warning lights for teachings or possible solutions. In this regard, the above-summarized discussion in the background portion of Naruke provides perspective on the particular problem sought to be addressed by Naruke.

One of ordinary skill in the art would readily understand that the problems which Naruke seeks to address -- avoiding the need for forming a hole in a vehicle door, freeing up space inside the door that can be used for other vehicular equipment -- are not at all applicable to vehicle windshields such as disclosed in Baldridge or laminated glazing panels such as recited in Claim 1 of the present application. Thus, there exists no reason why an ordinarily skilled artisan would look to vehicle door warning lights for disclosures that should be applied to windshields such as disclosed in Baldridge or laminated glazing panels such as recited in Claim 1 here.

In addition, nowhere does Naruke state or even imply that all applications utilizing indicator devices can, or should, be replaced with Naruke's disclosure of light emitting elements 5 positioned on a circuit board 6. Thus, there exists no relevant disclosure in Naruke itself that would cause an ordinarily skilled artisan to understand that Baldridge's indicator devices should be replaced with light emitting elements 5 as proposed by the Examiner here.

In an apparent attempt to find some reason or rationale supporting the rejection, the Examiner references several comments in Naruke discussing the use of the strip-mounted light emitting elements. Naruke notes that light emitting elements 5 reduce power consumption while the flexible printed circuit board allows the warning light strip to conform to the shape of the vehicle door side face. The Examiner relies upon these benefits as the explanation for why an ordinarily skilled artisan would find Naruke's light emitting elements 5 a good substitute for Baldridge's indicator devices. The Examiner's reliance is misplaced.

First, Baldridge certainly does not recognize that power consumption or shape conforming ability are concerns in the context of the disclosed indicator devices. And Naruke certainly does not recognize that the advantages associated with the disclosed construction of the vehicle door warning light strip can also be realized when applied to windshields.

In addition, to the extent the Examiner believes it relevant to consider Naruke's discussion of the advantages associated with using light emitting diodes, the context in which those advantages are discussed must also be considered.

Naruke mentions the reduction in power consumption associated with the use of light emitting elements because the light emitting elements described in Naruke replace the large light body 63 previously used in other known vehicle door warning lights. Compared to these large light bodies, the light emitting elements 5 might be said to reduce power consumption. However, Baldridge's windshield does not use large light bodies such as those associated with prior known vehicle door warning lights as described in Naruke. Indeed, by their very nature and the context in which they are used, the signal lights mentioned in Baldridge are rather small and not susceptible to the same power consumption shortcomings as the large vehicle door warning lights mentioned in the background portion of Naruke. Certainly, Baldridge does not describe or otherwise suggest that the signal lights are susceptible to large amounts of power consumption. Thus, no basis exists for concluding that a need exists to reduce power consumption of Baldridge's signal lights. Nor has it been established that Naruke's light emitting elements would actually reduce power consumption compared to the indicator devices used by Baldridge.

Naruke views the flexible nature of the printed circuit board beneficial because it is necessary to adhere the warning light strip to the side face of the vehicle door as discussed in the first full paragraph of column 5 of Naruke. That is, the warning light strip must be able to conform to the uneven surface variations along the side face of the vehicle door in order to be properly mounted on the vehicle door. This same concern is not particularly relevant in the case of a laminated glazing as claimed here (or a windshield such as described in Baldridge) where the light emitting diodes, mounted on a circuit board, are not adhered in place, but rather are laminated between glass planes. Here, there is little benefit to be derived from conforming the circuit board, given the lamination process to which the light emitting diodes, mounted on the circuit board, are subjected.

A still further reason why an ordinarily skilled artisan would not have viewed Naruke's disclosure as relevant to Baldridge's windshield or the laminated glazing here is that Naruke has nothing to do with laminating one or more light emitting diodes, mounted on a circuit board, between two glass plies. Naruke merely describes light emitting elements provided on a printed circuit board and covered by a protective elastic sheet 55.

The present application describes development of the invention here and points out that the inventor here very surprisingly discovered, contrary to conventional wisdom, that it is possible to produce a usable laminated glazing panel in which one or more light emitting diodes mounted on a circuit board are laminated between two glass plies. The reason this discovery was so surprising is that the conditions under which laminated glazing panels are produced are quite severe and harsh.

The present application discusses that the production of laminated glazing panels involves subjecting the plies to quite significant process parameters involving, for example, temperatures of at least 100°C and pressures in excess of several atmospheres. Further, the laminated glazing panel is subjected to these conditions for a relatively extended period of time. Prior to the development of the present invention, individuals of ordinary skill in the art did not believe it possible to fabricate laminated glazing panels with light emitting diodes. This common thinking was based on the belief that the light emitting diodes would not be capable of withstanding the high process parameters to which the various plies are subjected during the laminated glazing panel manufacturing process.

To help explain and understand this point, attached in the Evidence Appendix are LED product specification sheets for products manufactured by three different manufacturers -- Kingbright, Toshiba and Osram. These specification sheets set forth various rating specifications for the LEDs, meaning the maximum and minimum conditions which the LEDs can withstand. The specification sheets presented in the Evidence Appendix were presented to the Examiner in the Amendment filed on November 5, 2007 and entered by way of the January 25, 2008 Official Action.

The specification sheet for the Kingbright LED states that the operating temperature range is -40°C to +85°C, while the storage temperature range is -40°C to +90°C. The specification sheet for the Toshiba LED indicates an operating temperature range of -25°C to +80°C and a storage temperature range of -30°C to +85°C. Finally, the specification sheet for the Osram LED indicates an operating temperature range of -30°C to +85°C and a storage temperature range of -40°C to +85°C.

The specification sheets of these LED products make clear that the LEDs have maximum operating and storage temperature specifications well below the minimum 100°C temperature to which laminated glazing panels are subjected during the manufacturing process. This explains at least in part why individuals skilled in the art did not believe it was possible to produce a laminated glazing panel in which one or more light emitting diodes mounted on a circuit board are embodied in the laminated glazing panel. With the maximum operating and storage temperatures of LED products well below the minimum temperature to which laminated glazing panels are subjected during the lamination process, it is understandable why ordinarily skilled artisans did not believe it possible to manufacture laminated glazing panels with light emitting diodes. Baldridge also discusses a lamination temperature of 93.33°C-162.78°C (200°F-325°F). Even the low end of this range significantly exceeds the maximum operating temperature range set forth in the LED product specification sheets.

Through developmental efforts, the inventor here discovered quite surprisingly (as noted on page two of the present application) that one or more light emitting diodes mounted on a circuit board laminated between two glass plies can indeed survive the quite harsh process conditions associated with the lamination process. The inventor is unable to explain why it is that the invention here succeeds where others skilled in the art previously believed it impossible.

The Examiner attempts to respond to the evidence presented in the LED specification sheets by pointing out a temperature in one of the LED specification sheets that exceeds the laminating temperature of about 100°C to 150°C recited in Claim 1, and the other independent claims. Specifically, the Examiner mentions that the page identified as "J-5" at the middle bottom of the page lists a Reflow Soldering Temperature of 260°C for 5 seconds. The Examiner seems to imply that this reflow soldering temperature supports the view that LED's are able to withstand the temperature conditions encountered during manufacture of a laminated glazing panel. The Examiner's observation is both incorrect and misleading.

To explain, pages 5 and 6 of the Kingbright specification sheets illustrate methods for mounting or soldering LED leads. It is apparent from these illustrations, and consistent with general knowledge in the art, that the LED itself is spaced from

the region of solder. It is thus not surprising that the Reflow Soldering Temperature rating of the LED is 260°C as noted in the specification sheets. However, that the LEDs are able to withstand reflow soldering at 260°C for 5 seconds when the LED is spaced from the solder region is hardly an indication that the LED can withstand the conditions encountered during manufacture of a glazing panel. To say otherwise is to mislead. As a way of facilitating an understanding of the conditions encountered during typical glazing panel manufacturing, attached in the Evidence Appendix is a short paper discussing how to make a good laminated safety glass for windscreens. A copy of this paper was submitted to the Examiner with the Amendment filed on November 20, 2008 and was entered by way of the December 16, 2008 Advisory Action. The paper clearly describes how the glazing is subjected to quite high temperature and pressure conditions for an extended period of time, certainly many times longer than the 5 second interval occurring during reflow soldering. Thus, it can hardly be said that the ability of the LED to undergo reflow soldering at a temperature of 265°C for 5 seconds evidences that the LED can withstand the conditions encountered during laminated glazing panel manufacturing. Certainly, one of ordinary skill in the art, knowledgeable about the conditions under which laminated glazing panels are produced and aware of how LEDs are rated for reflow soldering temperature, would readily appreciate that a reflow soldering temperature rating of 265°C for 5 seconds in no way is an indication that the LED can be subjected to the conditions, including temperature conditions, encountered during laminated glazing panel manufacture.

The Examiner also tries to respond to the arguments about the temperature ratings of the LEDs in a different fashion. Here, the Examiner states that if LED's subjected to Baldrige's disclosed temperature range of 93.33°C-162.78°C (200°F-325°F) would be destroyed or rendered inoperable, so too would LEDs subjected to the temperature range recited in Claim 1. Clearly, the Examiner has missed the point. The obviousness inquiry requires consideration of what a person of ordinary skill in the art would have found obvious at the time of invention based on prior art disclosures. The thought process of this ordinarily skilled artisan would most assuredly have been affected and perhaps altered by conventional thinking of others in the art at that time of invention. Here, as discussed above, common wisdom at

the time of the invention was that LEDs would be unable to withstand the harsh and severe conditions encountered during manufacture of laminated glazing panels. The specification sheets support this view. This thinking is not altered by the fact that the developmental efforts of the inventor here led to the discovery (for reasons unknown to the inventor) that it is possible to successfully produce an LED-outfitted laminated glazing panel even though the LED is subjected to the glazing panel manufacturing conditions.

It is thus submitted that the Examiner's position here lacks findings of fact sufficient to properly support the conclusion of obviousness. The Supreme Court's decision in *KSR* explained that patentability may not be found where the results achieved by combining the prior art are predictable. *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727 [82 USPQ2d 1385] (2007). This is not such a case. Indeed, the result which would have been predicted here is just the opposite of what was actually achieved. As discussed above, persons of ordinary skill in the art understood that LEDs would not be able to withstand the manufacturing conditions occurring during manufacture of a laminated glazing panel. Thus, to the extent the record here establishes anything about predictability, it is that replacing Baldridge's instrument indicators with Naruke's light emitting elements is useless because the result would be a laminated glazing panel with inoperable light emitting elements. What the inventor here achieved by proceeding contrary to conventional wisdom is a result that is anything but predictable.

The obviousness rejection here seems premised on little more than the observation that LEDs exist in the prior art. That is not a sufficient finding upon which to base an obviousness rejection. That is, the Supreme Court's decision in *KSR* does not stand for the proposition that obviousness can be based merely upon showing that the claimed elements exist in the prior art. Indeed, the Supreme Court noted in *KSR* "that obviousness cannot be proven merely by showing that the elements of a claimed device were known in the prior art; it must be shown that those of ordinary skill in the art would have had some 'apparent reason to combine the known elements in the fashion claimed.' *Ex parte Whalen*, 89 USPQ2d 1078, 1084 (BPAI 2008). Here, the evidence of record and the knowledge of ordinarily skilled artisans as discussed above leads away from the invention at issue here.

As a final point, the Examiner dismisses the Claim 1 language reciting that the glass plies and the plastic ply are laminated with the light emitting diode(s) at a temperature of about 100°C to 150°C. The Examiner views this claim language as a product-by-process limitation, and refuses to consider this aspect of the claimed laminate. Once again, the Examiner misses the point. This language in Claim 1 makes clear one of the process parameters under which the laminated glazing panel is manufactured. This language supports the argument set forth above that persons of ordinary skill in the art believed that LEDs were not capable of withstanding the process parameters to which laminated glazing panels are subjected during manufacture. This is supported by the LED specification sheets attached in the Evidence Appendix which show maximum temperature ratings significantly below the lower limit of the temperature range recited in Claim 1.

The arguments presented above apply equally to dependent Claims 2, 10, 11 and 13.

Independent Claim 16

Independent Claim 16 defines a process for producing a laminated glazing panel. All of the arguments presented above with respect to independent Claim 1 apply equally here and are incorporated herein by reference. The Claim 16 process is patentably distinguishable over the combination of the disclosures in Baldrige and Naruke for additional reasons as well.

Independent Claim 16 defines that the lamination of the two glass plies, the plastic ply, and the circuit board with light emitting diode(s) is performed at a temperature of about 100°C to 150°C. The Examiner's position about ignoring the temperature range specified in Claim 1 cannot apply to Claim 16 as Claim 16 is directed to the process for producing a laminated glazing panel. This is a further reason why Claim 16 is allowable.

Claim 16 additionally recites that the process for producing a laminated glazing panel involves pairing together two plastic plies, preparing a cut-out area in the upper plastic ply, positioning a circuit board with light emitting diode(s) in the cut-out area, and joining a further plastic ply to the paired plastic plies to create a

composite ply that is interleaved between two glass plies and subsequently laminated.

The discussion beginning in line 19 of column 3 of Baldridge describes a manufacturing method involving positioning an organic plastic interlayer between a pair of pellucid panels, and bonding that assembly together. Baldridge goes on to describe that if the indicator device is relatively thin compared to the plastic interlayer thickness, the indicator device can be placed between the plastic interlayer and the glass plate to embed the indicator in the plastic during the subsequent bonding operation. Alternatively, Baldridge describes cutting portions of the plastic interlayer to provide a recess for the indicator, or laminating the indicator between two layers of plastic located between the two glass plates.

Nowhere does Baldridge describe positioning, in a cut-out area in one plastic ply of a pair of plastic plies, a circuit board on which are mounted one or more light emitting diodes, and joining a further plastic ply to the paired plastic plies to create a composite ply subsequently interleaved between two glass plies. As explained in the paragraph at the top of page 10 of the August 20, 2008 Official Action, the Examiner states that it would have been obvious to include a third plastic layer in Baldridge's glazing "since it has been held that mere duplication of the central working parts of a device involves only routine skill in the art." This time-worn approach to rejecting a claim which sets forth subject matter not otherwise disclosed in the prior art is not well substantiated. The Official Action does not explain why such a construction would be desirable in the context of the glazing disclosed in Baldridge. For example, the Examiner does not explain why an ordinarily skilled artisan would deem it appropriate to add another layer of plastic. Persons of ordinary skill in the art are well aware that cost-increasing activities like adding a third layer are not typical or routine. They certainly are not performed merely as a way of duplication the central working parts. In addition, adding a third layer would add additional weight, once again contrary to accepted practices in the art. Thus, the record here lacks appropriate findings of fact and a discussion of relevant disclosures in the cited references to support the obviousness rejection.

Independent Claim 30 and Dependent Claims 14, 27 and 29

Independent Claim 30 is directed to the laminated glazing panel. All of the arguments presented above with respect to independent Claim 1 apply equally to independent Claim 30 and are incorporated herein by reference.

In addition, independent Claim 30 recites that the laminated glazing panel possesses a thickness of 8 mm or less, and the light emitting diode device (comprising one or more light emitting diodes mounted on a circuit board) possesses a thickness less than 0.8 mm. The record here must establish that an ordinarily skilled artisan would have believed, contrary to the accepted thinking at the time of development of the present invention, that it would be possible to produce a laminated glazing panel having the claimed thickness with an operational light emitting diode possessing a thickness as claimed, and with the laminated glazing panel produced under at least the temperature conditions specified in Claim 30. This the Examiner has not done. Indeed, the Examiner's response to the language in Claim 30 reciting the thickness of the glazing panel and the light emitting device is the same over-used and unsubstantiated argument referenced elsewhere during prosecution of this application. That is, the Examiner states that it would have been obvious to an ordinarily skilled artisan to adopt thicknesses for the modified glazing panel and light emitting diode device of Baldridge as claimed "since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involved only routine skill in the art." The issue here is not whether a glazing panel thickness of 8 mm or less and/or a light emitting diode thickness of 0.8 mm or less is known. Rather, the issue is whether one of ordinary skill in the art, based on the disclosures in Baldridge and Naruke, would have deemed it obvious to depart from the common thinking at the time (i.e., that light emitting diodes are incapable of withstanding the manufacturing conditions under which laminated glazing panels are manufactured) and replace the instrument device disclosed in Baldridge with one or more light emitting diodes mounted on a circuit board. Claim 30 specifies additional details associated with the laminated glazing panel that an ordinarily skilled artisan would take into account when considering the possibility of manufacturing a laminated glazing panel with one or more light emitting diodes mounted on a circuit board.

Even if there was merit to the Examiner's position, the premise he espouses is not supported. The Examiner states that that it would have been obvious to use thicknesses for Baldrige's modified glazing panel and light emitting diode device as a part of discovering the optimum or workable ranges. However, the Examiner has not established that the "optimum or workable ranges" which an ordinarily skilled artisan would pursue in accordance with the disclosures of Baldrige and Naruke are the same as the claimed thicknesses. Absent such a showing, it cannot be said that the "optimum or workable ranges" which the ordinarily skilled artisan would arrive at while implementing the disclosures in Baldrige and Naruke are the same as those recited in Claim 30.

Dependent Claims 14, 27 and 29 are patentable over the applied references for similar reasons.

Dependent Claim 9

Dependent Claim 9 depends from Claim 1 and recites indicia on at least one ply. The Official Action states that the discussion in lines 41-60 of column 3 of Baldrige describes indicia on at least one ply. However, lines 41-60 of Baldrige say nothing about indicia. Rather, this portion of the disclosure in Baldrige describes additional details associated with the construction of the disclosed laminated panel. Accordingly, the Examiner has not provided sufficient findings of fact to support the rejection of Claim 9.

Dependent Claims 24, 26 and 32

Claims 24, 26 and 32 define that the lamination of the two glass plies and the plastic ply is performed at a pressure of about 5 to 15 atmospheres. This language further defines the manufacturing parameters under which the laminated glazing panel is manufactured and, in conjunction with the temperature range specified in the independent claims, further supports the view that persons of ordinary skill in the art did not believe it possible to produce a laminated glazing panel in which a light emitting diode is subjected to laminating conditions such as specified in the

independent claims and Claims 24-26 and 32 to produce a laminated glazing panel. It is thus respectfully submitted that those dependent claims further patentably distinguish the claimed invention.

B. The rejection of Claims 8, 12, 15, 17, 18, 22, 25 and 28 under 35 U.S.C. § 103(a) as being unpatentable over Baldrige and Naruke, and further in view of U.S. Patent No. 4,968,895 to Leclercq (hereinafter Leclercq).

Independent Claim 15 and Dependent Claims 8, 18 and 22

Independent Claim 15 defines the process for producing a laminated glazing panel. All of the arguments set forth above with respect to Claim 1 apply equally here and are incorporated herein by reference.

In addition, Claim 15 defines that the lamination of the two glass plies, the plastic ply, and the circuit board with light emitting diode(s) is performed at a temperature of about 100°C to 150°C. The Examiner's position that the temperature range specified in Claim 1 can be ignored because Claim 1 is a product claim, does not apply to Claim 15. The reason is because Claim 15 defines the process for producing a laminated glazing panel. This is thus a further reason why Claim 15 is allowable.

Dependent Claim 12

Dependent Claim 12 recites that the one or more light emitting diodes and the circuit board together are at least partially coated in a material compatible with the material of the plastic ply. Claim 12 is rejected based on the disclosures in Baldrige and Naruke, and further in view of the description in Leclercq. Leclercq discloses a laminated glass in which a photodiode is buried in the plastic interlayer positioned between two outside glass sheets. Leclercq states in lines 46-49 of column 2 that the photodiode should be coated with plastic compatible with the plastic of the interlayer.

The disclosure in Leclercq specifically pertains to the coating of a photodiode. Leclercq recognizes that the small dimensions of the photodiode render the device quite fragile. For this reason, Leclercq proposes coating the photodiode with plastic, preferably a plastic compatible with the plastic of the interlayer.

In contrast, Naruke describes an LED whose construction is completely different from the photodiode described in Naruke. The fragile nature of the Leclercq's photodiode results from the very small dimensions of the photodiode. The LED described in Naruke is not the same and is not disclosed as being similarly fragile. Thus, the reason underlying Leclercq's proposed use of a plastic coating (i.e., to address the very fragile nature of the photodiode) does not exist in the case of Baldrige or Naruke. Thus, sufficient findings of fact do not exist to support the conclusion that it would have been obvious to utilize Leclercq's plastic coating in connection with the light emitting element described in Naruke.

Further, Claim 12 recites that both the light emitting diode(s) and the circuit board together are at least partially coated in a material compatible with the material of the plastic ply. There is no disclosure in Leclercq, or elsewhere, of coating a circuit board, at least partially, with the disclosed material. Thus, sufficient findings of fact have not been established to support the obviousness rejection of Claim 12.

Dependent Claim 17

Claim 17 above recites that the circuit board and one or more light emitting diodes together are at least partially coated with a material compatible with the material of the plastic ply. This claim is similar to Claim 12 discussed above and so the arguments presented above regarding Claim 12 apply equally here and are incorporated by reference.

Dependent Claim 25

Claim 25 defines that the lamination of the two glass plies and the plastic ply is performed at a pressure of about 5 to 15 atmospheres. This claim is similar to

Claims 24, 26 and 32, and so the arguments set forth above regarding Claims 24, 26 and 32 apply equally here and are incorporated herein by reference.

Dependent Claim 28

Claim 28 recites that the laminated glazing panel possesses a thickness equal to or less than 8 mm. The arguments presented above regarding Claims 30, 14 and 29 apply equally here and are incorporated herein by reference.

C. The rejection of Claim 31 under 35 USC § 103(a) as being unpatentable over Baldridge in view of Naruke, and further in view of U.S. Patent No. 4,761,720 to Solow (hereinafter Solow).

Dependent Claim 31

Claim 31 depends from Claim 30 and recites that the thickness of the light emitting diode device is less than the thickness of the plastic ply. The Examiner addresses this claim by referring to the disclosure in Solow.

Solow describes an illuminated tape used for decorative lighting such as Christmas light strands. The discussion in the middle of column 3 of Solow points out that the electrical elements are embedded in the plastic tape so that the tape is waterproof. However, this disclosure in Solow of manufacturing a stand-alone tape for decorative lighting purposes (e.g., a string of Christmas lights) is hardly a disclosure that one of ordinary skill in the art would find applicable to manufacturing laminated glazing panels comprised of a light emitting diode device and a plastic ply laminated between two glass plies. Indeed, considering the manner in which Solow's lighting string is to be used, it is not surprising that the electrical components would be embedded in the plastic tape. However, that same reasoning does not apply in the context of a laminated glazing panel where a light emitting diode(s) and a plastic ply are laminated between two glass sheets. The reasons why one would embed the electrical components in the plastic layer of the decorative lighting string described in Solow do not apply in the case of a laminated glazing panel as recited

in Claim 31. It is thus respectfully submitted that appropriate findings of fact have not been presented to support the obviousness rejection of Claim 31.

IX. Conclusion

All of the claims at issue here require a laminated glazing panel in which a circuit board with light emitting diode(s) is laminated between glass plies and with a plastic interlayer. But the Examiner has not *prima facie* established why an ordinarily skilled artisan would have found it obvious to produce a laminated glazing panel in which the light emitting diode(s) is laminated between glass plies with a plastic interlayer. The Examiner has merely shown that LED's were known. Ordinarily skilled artisans believed that it was not possible to produce a laminated glazing panel in which a LED is laminated between glass plies with a plastic interlayer. The reason is because it was understood that LEDs could not withstand the harsh and severe conditions under which the laminating procedure is performed. Through developmental efforts, the inventor here discovered, contrary to conventional thinking, that it was possible to produce a laminated glazing panel in which a LED is laminated between glass plies with a plastic interlayer. The rejection here is not supported by sufficient findings of fact and articulated reasons supporting the obviousness determination. It is respectfully requested that the current rejections be overturned and the claims in this application allowed.

X. Claims Appendix

The attached Claims Appendix presents the claims involved in this appeal.

XI. Evidence Appendix

The attached Evidence Appendix includes several evidentiary exhibits referenced in the arguments above.

XII. Related Proceedings Appendix

See attached Related Proceedings Appendix for copies of decisions identified in Section II, supra.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date April 20, 2009

By:



Matthew L. Schneider
Registration No. 32814

Customer No. 21839
703 836 6620

X. CLAIMS APPENDIX

The Appealed Claims

1. A laminated glazing panel comprising two glass plies, a plastic ply and one or more light emitting diodes which are laminated between the glass plies, wherein the one or more light emitting diodes are mounted on a circuit board, and wherein the glass plies and the plastic ply with the one or more light emitting diodes are laminated at a temperature of about 100°C to 150°C.
2. A laminated glazing panel as claimed in claim 1 wherein the circuit board includes a flexible circuit board comprising a substrate and a conductive layer.
3. A laminated glazing panel as claimed in claim 2 wherein the substrate comprises polyimide.
4. A laminated glazing panel as claimed in claim 2 wherein the substrate comprises polyester.
5. A laminated glazing panel as claimed in claim 2 wherein the conductive layer is a metal foil which is adhered to the substrate.
6. A laminated glazing panel as claimed in claim 2 wherein the conductive layer is conductive ink which is in direct contact with the substrate.
7. A laminated glazing panel as claimed in claim 2 wherein the flexible circuit board further comprises a rigid layer.
8. A laminated glazing panel as claimed in claim 2 wherein the flexible circuit board extends outwardly beyond an edge of the glazing panel to enable connection of the circuit board to a power supply.
9. A laminated glazing panel as claimed in claim 1 further comprising indicia on at least one ply.
10. A laminated glazing panel as claimed in claim 1 wherein the plastic ply comprises a cut-out therein to aid successful lamination of the one or more light emitting diodes mounted on the circuit board in the glazing panel.

11. A laminated glazing panel as claimed in claim 1 wherein multiple plastic plies are used to laminate the one or more light emitting diodes mounted on the circuit board in the glazing panel.

12. A laminated glazing panel as claimed in claim 11 wherein the one or more light emitting diodes and the circuit board together are at least partially coated in a material compatible with the material of the plastic ply.

13. A laminated glazing panel as claimed in claim 1 wherein the plastic ply has a thickness before lamination of 2 mm or less.

14. A laminated glazing panel as claimed in claim 1 wherein the thickness of the said panel is 8 mm or less.

15. A process for the production of a laminated glazing panel comprising interleaving a plastic ply between two glass plies and laminating the plies, wherein, prior to lamination, a cut-out area is prepared in the plastic ply to receive a circuit board on which one or more light emitting diodes are mounted, said circuit board and one or more light emitting diodes together being at least partially coated with a material compatible with the material of the plastic ply, and the circuit board is positioned in the cut-out area in the plastic ply, wherein the laminating of the two glass plies and the plastic ply with the circuit board on which is mounted the one or more light emitting diodes is performed at a temperature of about 100°C to 150°C.

16. A process for the production of a laminated glazing panel comprising pairing together two plastic plies, preparing a cut-out area in the upper plastic ply to receive a circuit board on which one or more light emitting diodes are mounted, positioning said circuit board in the cut-out area, joining a further plastic ply to the paired plastic plies, thereby creating a composite ply, interleaving the composite ply between two glass plies, and laminating the two glass plies and the composite ply, including the circuit board on which is mounted the one or more light emitting diodes, at a temperature of about 100°C to 150°C.

17. A process for the production of a laminated glazing panel according to claim 16 wherein the circuit board and one or more light emitting diodes together are at least partially coated with a material compatible with the material of the plastic ply.

18. A process for the production of a laminated glazing panel according to claim 15 wherein the overall thickness of the coated circuit board on which one or more light emitting diodes are mounted is comparable with the thickness of the plastic ply in which it is positioned.

20. A laminated glazing panel as claimed in claim 3 wherein the conductive layer is a metal foil which is adhered to the substrate.

21. A laminated glazing panel as claimed in claim 1 wherein the plastic ply is made of polyvinylbutyral (PVB).

22. A process for the production of a laminated glazing panel according to claim 15 wherein the plastic ply is made of polyvinylbutyral (PVB).

23. A process for the production of a laminated glazing panel according to claim 16 wherein the two plastic plies that are paired together are made of polyvinylbutyral (PVB).

24. A laminated glazing panel as claimed in claim 1 wherein the glass plies and the plastic ply with the one or more light emitting diodes are laminated at a pressure of about 5 to 15 atmospheres.

25. A process for the production of a laminated glazing panel according to claim 15 wherein, the laminating of the two glass plies and the plastic ply with the circuit board on which is mounted the one or more light emitting diodes is performed at a pressure of about 5 to 15 atmospheres.

26. A process for the production of a laminated glazing panel according to claim 16 wherein the two glass plies and the composite ply including the circuit board on which the one or more light emitting diodes are mounted are laminated at a pressure of about 5 to 15 atmospheres.

27. A laminated glazing panel as claimed in claim 2 wherein the laminated glazing panel possesses a thickness equal to or less than 8 mm.

28. A process for the production of a laminated glazing panel according to claim 15 wherein the laminated glazing panel possesses a thickness equal to or less than 8 mm.

29. A process for the production of a laminated glazing panel according to claim 16 wherein the laminated glazing panel possesses a thickness equal to or less than 8 mm.

30. A laminated glazing panel comprising two glass plies, a plastic ply and a light emitting diode device laminated between the glass plies, the light emitting diode device which is laminated between the glass plies comprising one or more light emitting diodes mounted on a circuit board, wherein the glass plies and the plastic ply with the one or more light emitting diodes are laminated at a temperature of about 100°C to 150°C, wherein the laminated glazing panel possesses a thickness of 8 mm or less, and the light emitting diode device possesses a thickness less than 0.8 mm.

31. A laminated glazing panel as claimed in claim 30 wherein the thickness of the light emitting diode device is less than the thickness of the plastic ply.

32. A laminated glazing panel as claimed in claim 30 wherein the glass plies, the plastic ply and the light emitting diode device are laminated at a pressure of about 5 to 15 atmospheres.

XI. EVIDENCE APPENDIX

PRELIMINARY SPEC

Part Number: WP7104SRD/J

Super Bright Red

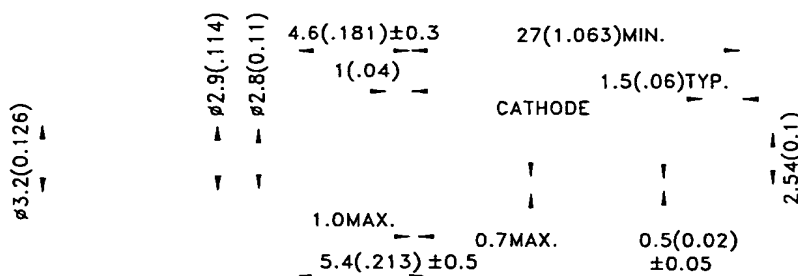
Features

- LOW POWER CONSUMPTION.
- POPULAR T-1 DIAMETER PACKAGE.
- GENERAL PURPOSE LEADS.
- RELIABLE AND RUGGED.
- LONG LIFE - SOLID STATE RELIABILITY.
- AVAILABLE ON TAPE AND REEL.
- RoHS COMPLIANT.

Description

The Super Bright Red source color devices are made with Gallium Aluminum Arsenide Red Light Emitting Diode.

Package Dimensions



Notes:

1. All dimensions are in millimeters (inches).
2. Tolerance is $\pm 0.25(0.01)$ unless otherwise noted.
3. Lead spacing is measured where the leads emerge from the package.
4. Specifications are subject to change without notice.



Kingbright

Selection Guide

Part No.	Dice	Lens Type	Iv (mcd) [2] @ 20mA		Viewing Angle [1]
			Min.	Typ.	2θ1/2
WP7104SRD/J	Super Bright Red (GaAlAs)	RED DIFFUSED	900	1200	40°

Notes:

1. θ1/2 is the angle from optical centerline where the luminous intensity is 1/2 the optical centerline value.
2. Luminous intensity/ luminous Flux: +/-15%.

Electrical / Optical Characteristics at TA=25°C

Symbol	Parameter	Device	Typ.	Max.	Units	Test Conditions
λpeak	Peak Wavelength	Super Bright Red	660		nm	If=20mA
λD [1]	Dominant Wavelength	Super Bright Red	640		nm	If=20mA
Δλ1/2	Spectral Line Half-width	Super Bright Red	20		nm	If=20mA
C	Capacitance	Super Bright Red	95		pF	Vf=0V;f=1MHz
Vf [2]	Forward Voltage	Super Bright Red	1.85	2.5	V	If=20mA
IR	Reverse Current	Super Bright Red		10	uA	VR = 5V

Notes:

1. Wavelength: +/-1nm.
2. Forward Voltage: +/-0.1V.

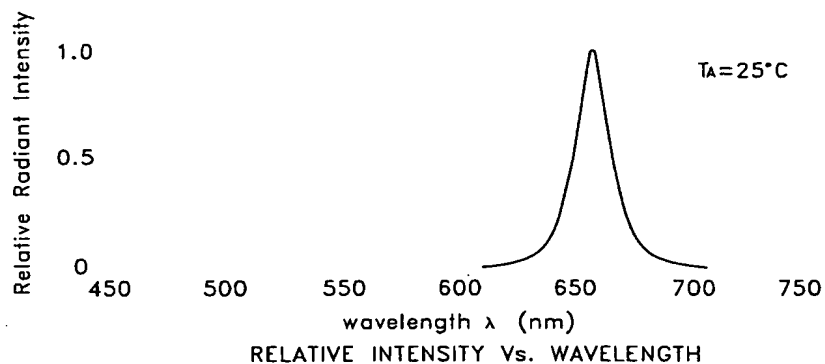
Absolute Maximum Ratings at TA=25°C

Parameter	Super Bright Red	Units
Power dissipation	75	mW
DC Forward Current	30	mA
Peak Forward Current [1]	150	mA
Reverse Voltage	5	V
Operating/Storage Temperature	-40°C To +85°C	
Lead Solder Temperature [2]	260°C For 3 Seconds	
Lead Solder Temperature [3]	260°C For 5 Seconds	

Notes:

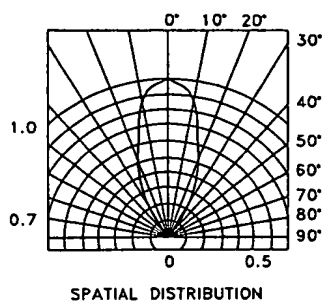
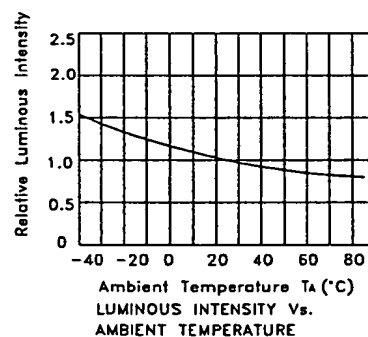
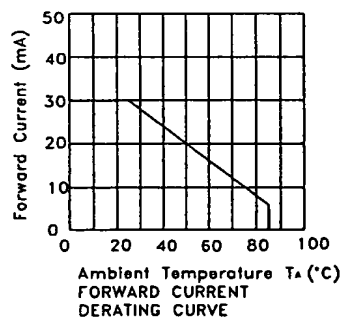
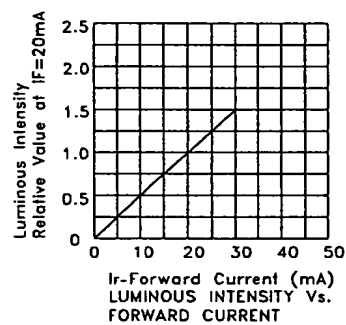
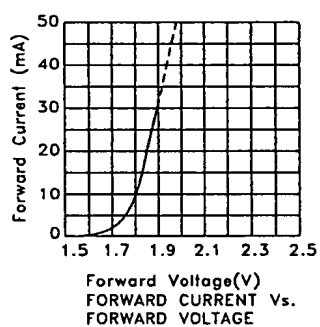
1. 1/10 Duty Cycle, 0.1ms Pulse Width.
2. 2mm below package base.
3. 5mm below package base.

Kingbright



Super Bright Red

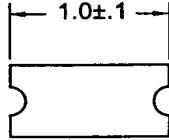
WP7104SRD/J



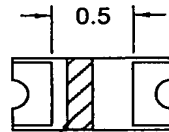
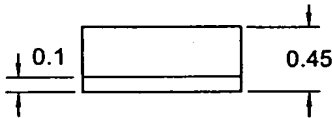
Surface Mount LED J Series for low current or superbright use, 0168 Series "0402" Package, mini-chip



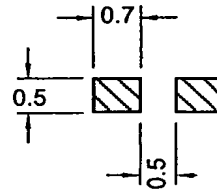
The 0168 series lamps are chip type 0402 size package designed for surface mounting. These lamps are very small and are used in applications where miniaturization is of primary concern. These lamps are available in EIA481 tape and reel packaging with 3000 pcs per reel.



RoHS Compliant
Aug 2004



Cathode Mark



Recommended
reflow
solder pattern

GENERAL INFORMATION

Operating Temperature Range	-40 °C to +85 °C
Storage Temperature Range	-40 °C to +90 °C
Reflow Soldering Temperature	260 °C for 5 sec max

APPLICATION INFORMATION (ALL RATINGS AT 25 °C AMBIENT)

Part No.	Emitted Color	Peak	$\Delta\lambda$	Absolute Maximum Ratings					E/O Characteristics					
		λ		Pd	If (mA)		Ir	Vr	Iv (mcd) @ If=20mA			Vf (V) @ If=20mA		$2\Theta_{1/2}$ (Deg)
		(nm)			dc	1/10 duty @ 1 kHz			2mA	Min	Typ	Min	Typ	
JRC0168	Red	632	20	60	25	160	10	5	2	15	36	2.0	2.4	120
JGC0168	Green	575	20	60	25	160	10	5	1	10	15	2.0	2.4	120
JYC0168	Yellow	591	15	60	25	160	10	5	2	15	38	2.0	2.4	120
JOC0168	Orange	621	18	60	25	160	10	5	2	15	38	2.0	2.4	120
JEC0168	OrRed	639	20	60	25	160	10	5	2	12	30	2.0	2.4	120
JYOC0168	YelOrng	611	17	60	25	160	10	5	2	15	38	2.0	2.4	120
JDC0168	DeepRd	650	20	60	25	160	10	5	2	12	30	2.0	2.4	120

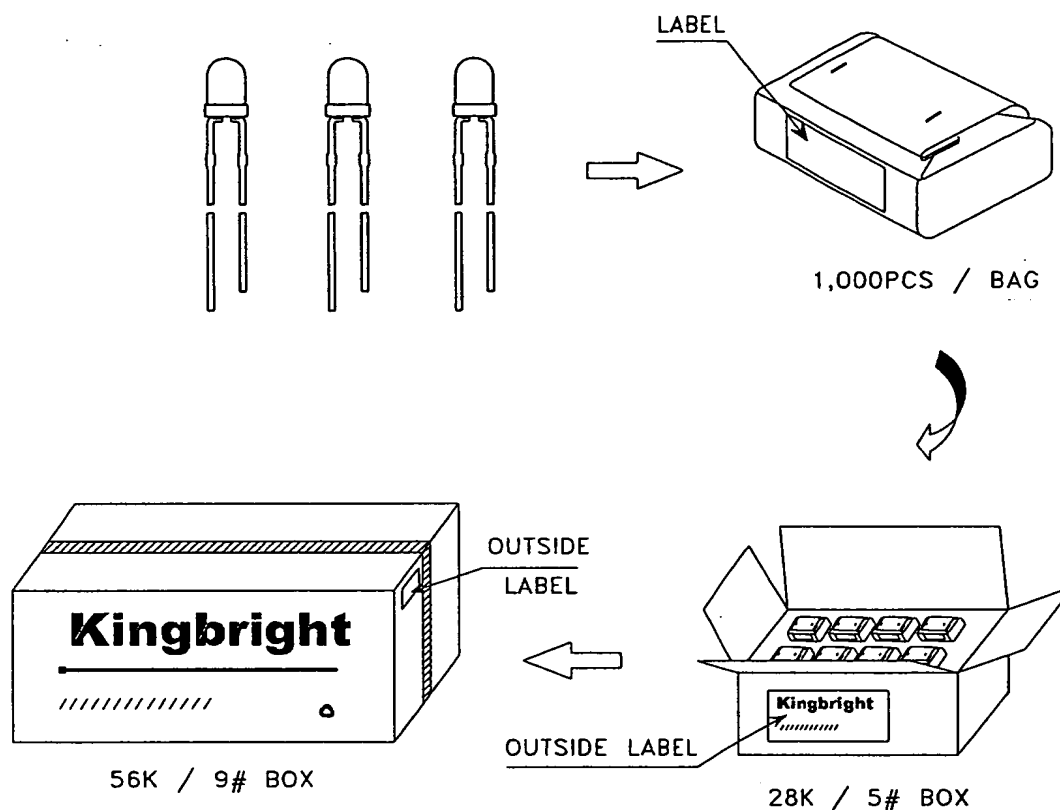
Specifications subject to change without notice. Dimensions are in mm ± 0.3 unless stated otherwise.


IDEA, Inc., 1351 Titan Way, Brea, CA 92821 Ph: 714-525-3302, 800-LED-IDEA; Fax: 714-525-3304 0508

013S-J0168

PACKING & LABEL SPECIFICATIONS

WP7104SRD/J



<h1>Kingbright</h1>	
Q.C.	QC XX XX XX PASSED
TYPE NO : WP7104xxx	
QUANTITY : 1,000 pcs	
S/N : XX	CODE: XX
LOT NO : 	
RoHS Compliant	

Kingbright

LED MOUNTING METHOD

1. The lead pitch of the LED must match the pitch of the mounting holes on the PCB during component placement. Lead-forming may be required to insure the lead pitch matches the hole pitch. Refer to the figure below for proper lead forming procedures.

(Fig. 1)

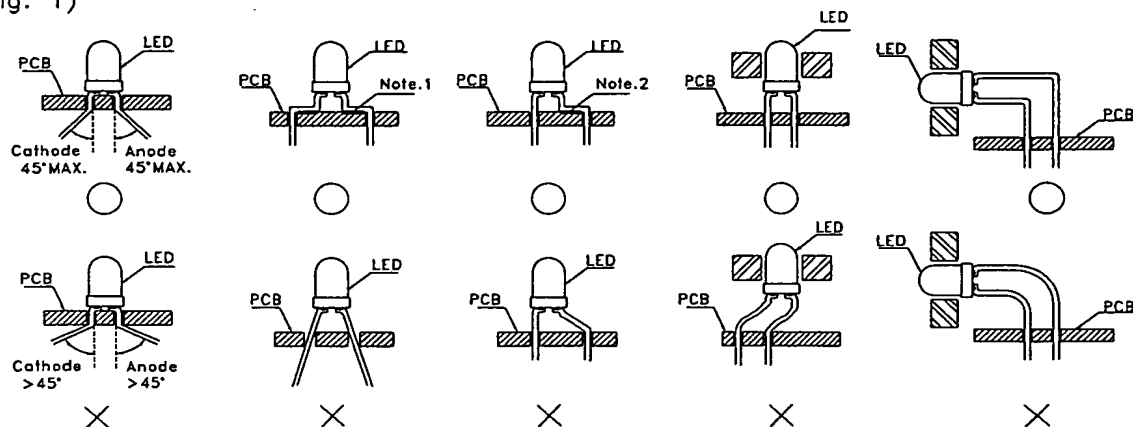


Fig.1

"○" Correct mounting method "X" Incorrect mounting method
 Note 1-2 : Do not route PCB trace in the contact area between the leadframe and the PCB to prevent short-circuits.

2. When soldering wire to the LED, use individual heat-shrink tubing to insulate the exposed leads to prevent accidental contact short-circuit.

(Fig. 2)

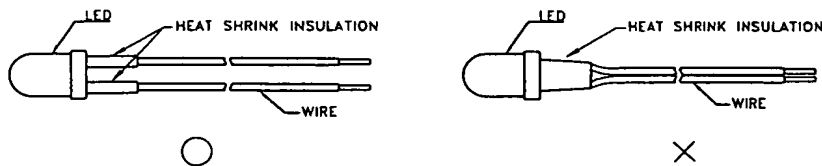


Fig. 2

3. Use stand-offs (Fig. 3) or spacers (Fig. 4) to securely position the LED above the PCB.

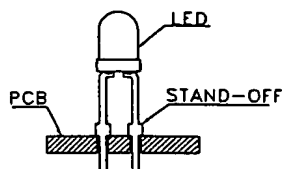


Fig. 3

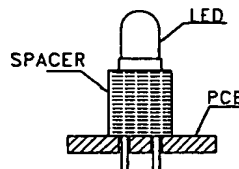


Fig. 4

LEAD FORMING PROCEDURES

1. Maintain a minimum of 2mm clearance between the base of the LED lens and the first lead bend. (Fig. 5 and 6)

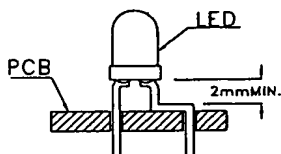


Fig. 5

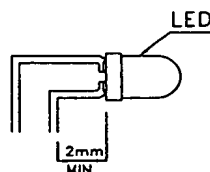


Fig. 6

2. Lead forming or bending must be performed before soldering, never during or after Soldering.
3. Do not stress the LED lens during lead-forming in order to fractures in the lens epoxy and damage the internal structures.
4. During lead forming, use tools or jigs to hold the leads securely so that the bending force will not be transmitted to the LED lens and its internal structures. Do not perform lead forming once the component has been mounted onto the PCB. (Fig. 7)
5. Do not bend the leads more than twice. (Fig. 8)

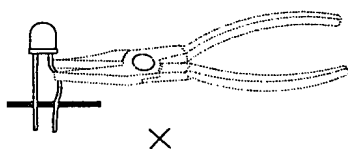


Fig. 7

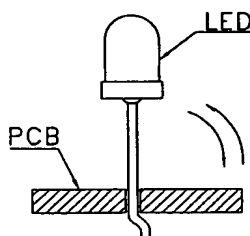


Fig. 8

6. After soldering or other high-temperature assembly, allow the LED to cool down to 50°C before applying outside force (Fig. 9). In general, avoid placing excess force on the LED to avoid damage. For any questions please consult with Kingbright representative for proper handling procedures.

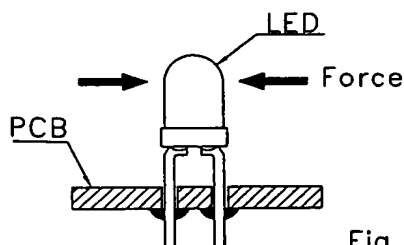


Fig. 9

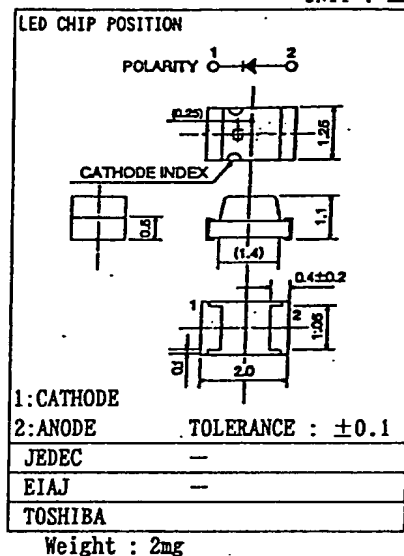
TECHNICAL DATA

TLSU1002, TLYU1002

UNIT : **11**

- 2.0(L)×1.25(W)×1.1(H)mm SIZE
- SMALL PACKAGE - HIGH DENSITY MOUNTING IS AVAILABLE
- AVAILABLE OF AUTOMOUNTING MACHINE USE
- REFLOW SOLDERING IS APPLICABLE
- APPLICATIONS: TELEPHONE CORDLESS/CELLULAR
PORTABLE INSTRUMENT, BACKLIGHT, etc.

PRODUCT NAME	COLOR	MATERIAL
TLGU1002	Green	InGaAlP
TLOU1002	Orange	InGaAlP
TLPGU1002	Pure Green	InGaAlP
TLSU1002	Red	InGaAlP
TLYU1002	Yellow	InGaAlP



PRODUCT NAME	Forward Current(DC) I _f (mA)	Reverse Voltage V _r (V)	Power Dissipation P _r (mW)	Operating Temperature T _{opr} (°C)	Storage Temperature T _{stg} (°C)
TLGU1002	25	4	70	-25~80	-30~85
TLOU1002	25	4	60		
TLPGU1002	25	4	70		
TL SU1002	25	4	60		
TL YU1002	25	4	62.5		

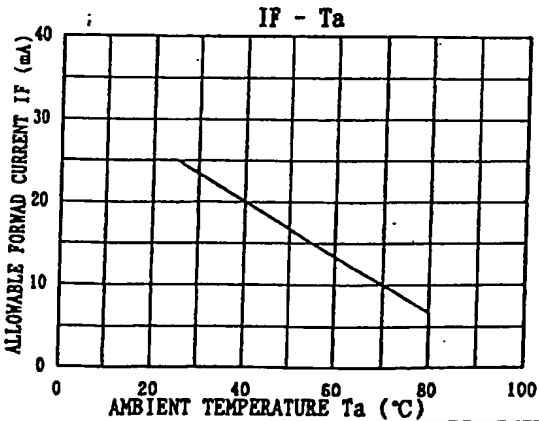
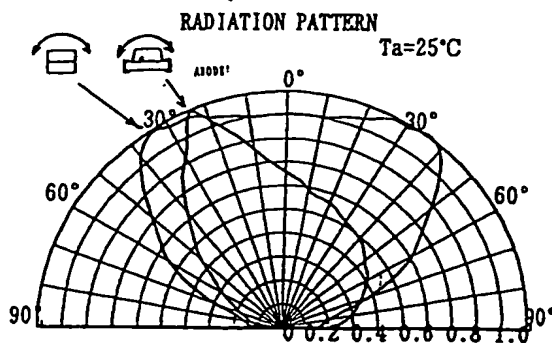
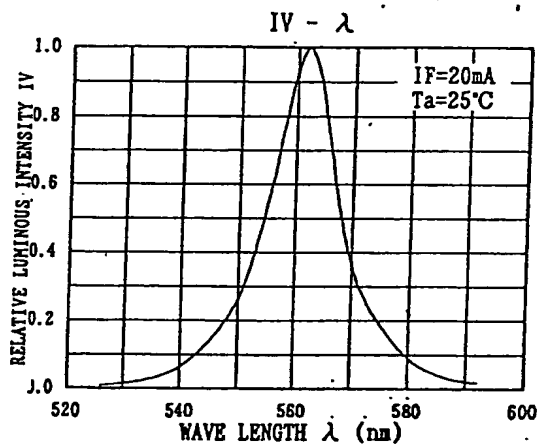
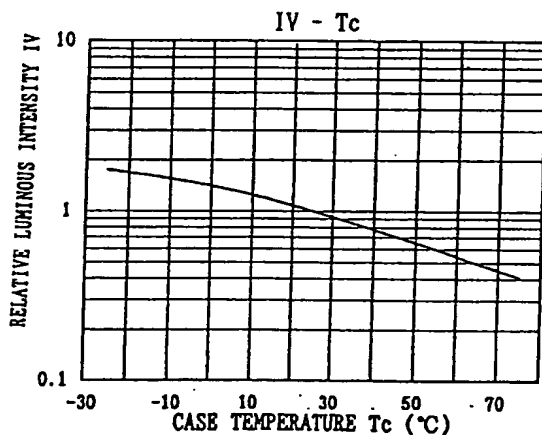
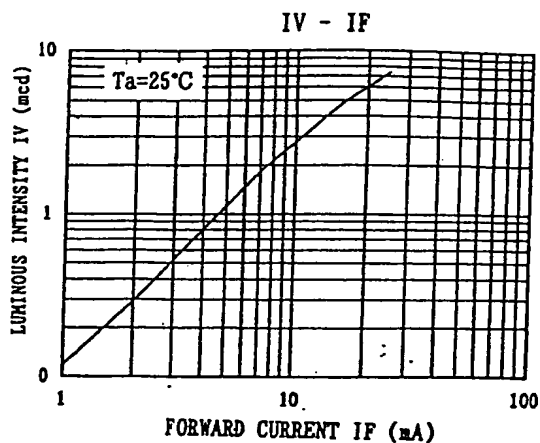
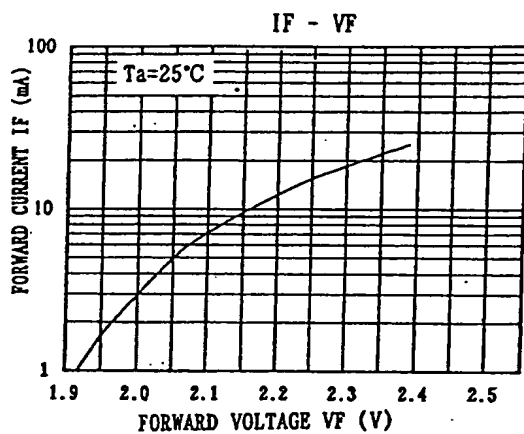
PRODUCT NAME	EMISSION SPECTRUM			LUMINOUS INTENSITY			FORWARD VOLTAGE			REVERSE CURRENT	
	λ ,	$\Delta\lambda$	I_f	I_f			V_f			I_r	
	Typ.	Typ.		Min.	Typ.	I_f	Typ.	Max.	I_f	Max.	V_r
TLGU1002	574	15	20	8.5	27	20	2.4	2.8	20	50	4
TLOU1002	612	15	20	15.3	40	20	2.0	2.4	20	50	4
TLPGU1002	562	13	20	1.53	6	20	2.3	2.8	20	50	4
TL SU1002	636	17	20	8.5	30	20	2.0	2.4	20	50	4
TL YU1002	590	13	20	8.5	30	20	2.1	2.5	20	50	4
UNIT	nm		μA	mcd		mA	V		mA	μA	V

TOSHIBA CORPORATION

SEMICONDUCTOR
TOSHIBA
TECHNICAL DATA

TLGU1002, TLOU1002, TLPGU1002
TLSU1002, TLYU1002

TLPGU1002



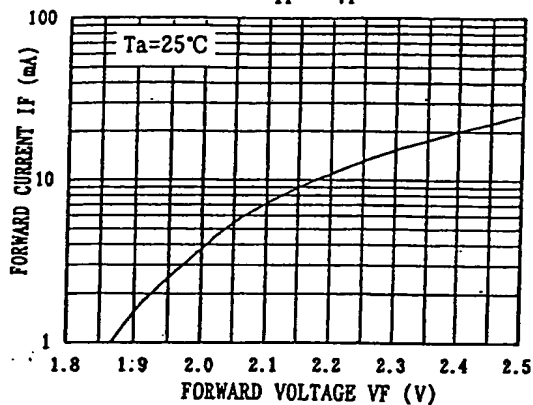
TOSHIBA CORPORATION

TOSHIBA
SEMICONDUCTOR
TECHNICAL DATA

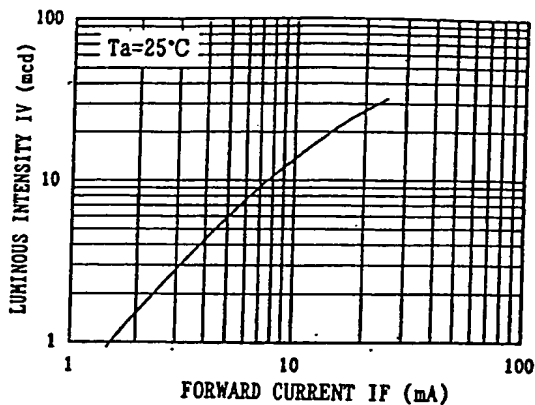
TLGU1002, TLOU1002, TLPGU1002
TLSU1002, TLYU1002

TLGU1002

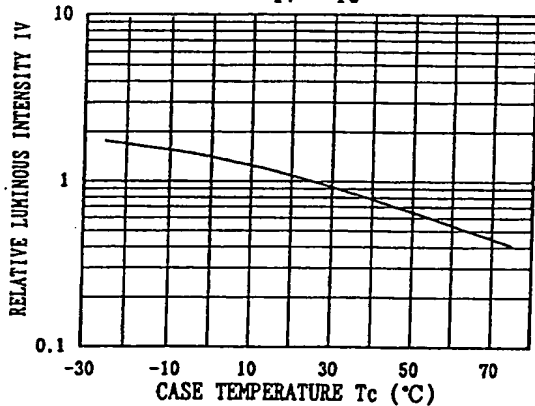
IF - VF



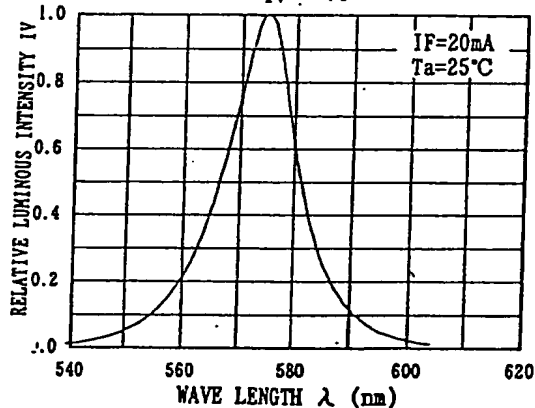
IV - IF



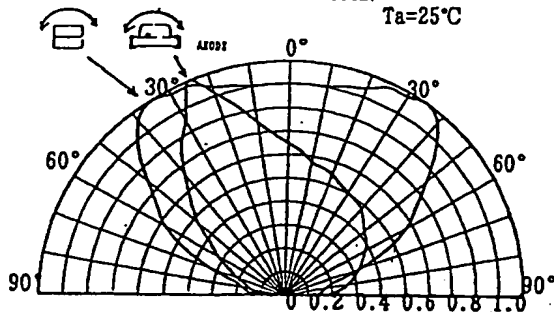
IV - Tc



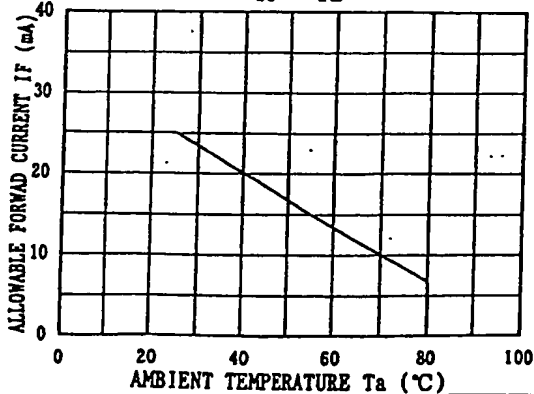
IV - λ



RADIATION PATTERN



IF - Ta



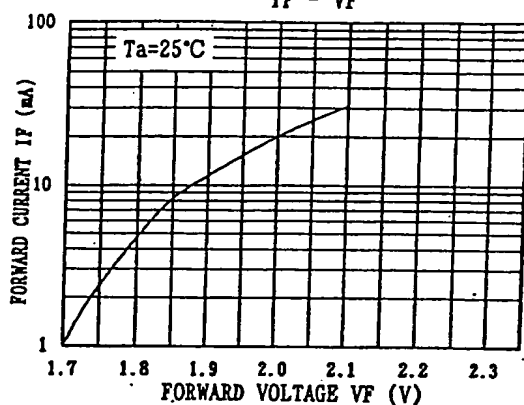
TOSHIBA CORPORATION

TOSHIBA
SEMICONDUCTOR
TECHNICAL DATA

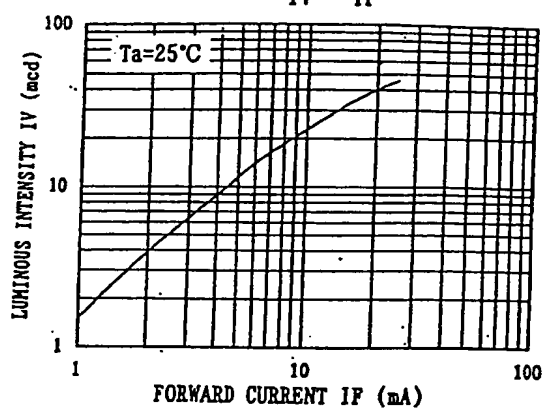
TLGU1002, TLOU1002, TLP GU100
TLSU1002, TLYU1002

TLOU1002

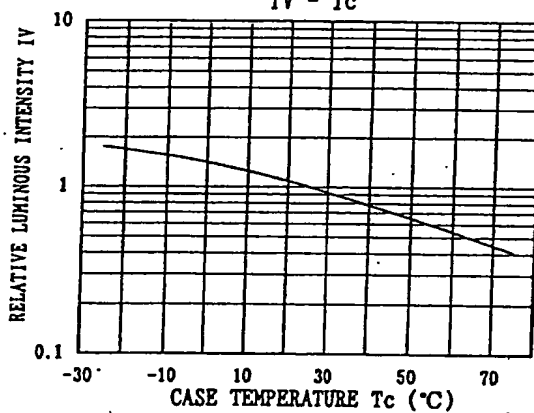
IF - VF



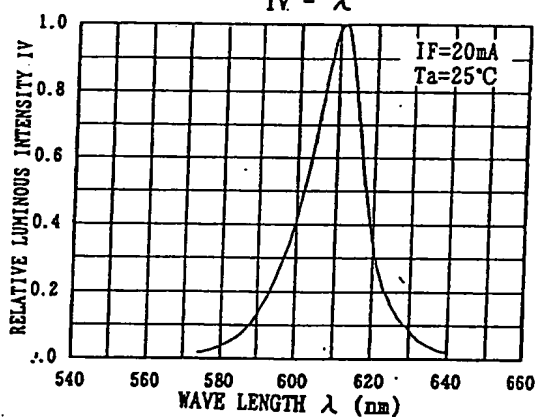
IV - IF



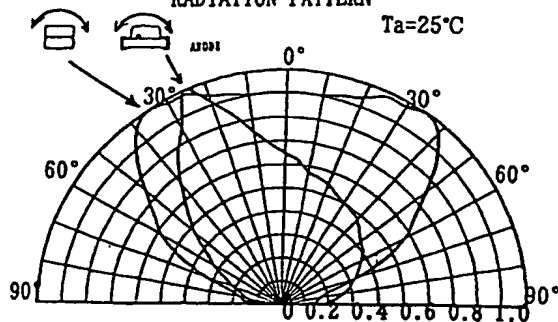
IV - Tc



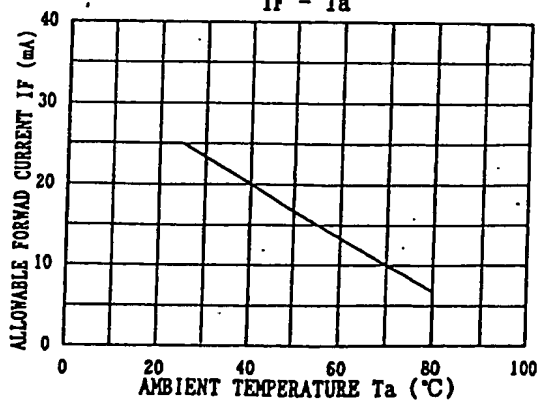
IV - λ



RADIATION PATTERN



IF - Ta



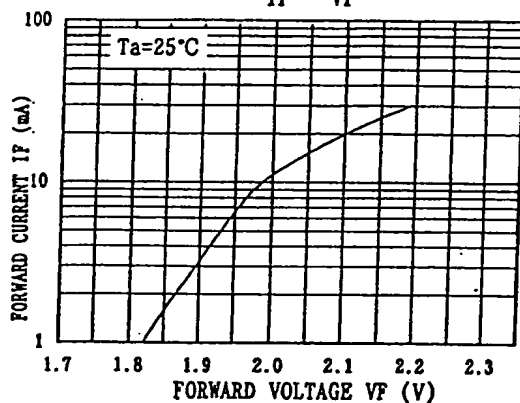
TOSHIBA CORPORATION

SEMICONDUCTOR
TOSHIBA
TECHNICAL DATA

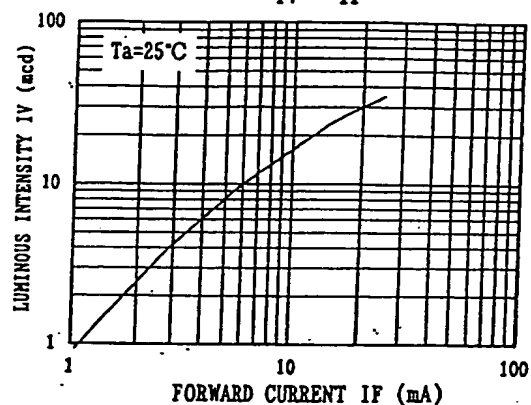
TLGU1002, TLOU1002, TLPGU1002
TLSU1002, TLYU1002

TLYU1002

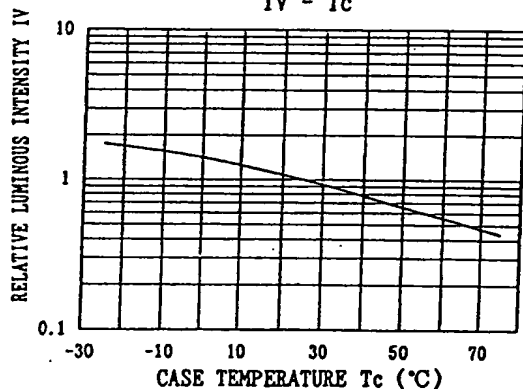
IF - VF



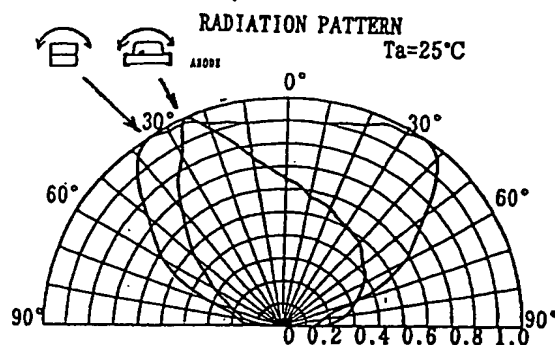
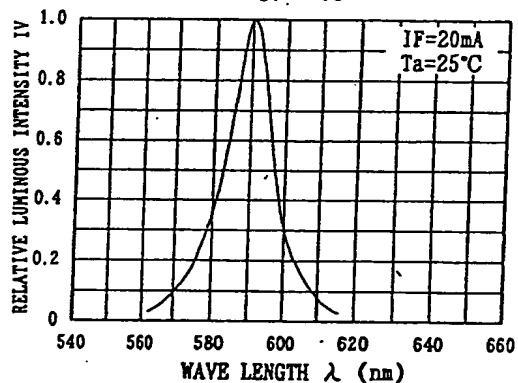
IV - IF



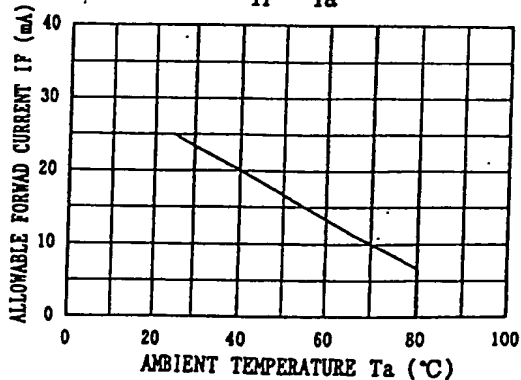
IV - Tc



IV - λ



IF - Ta

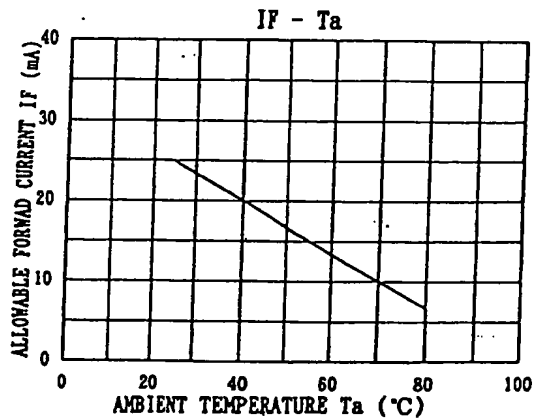
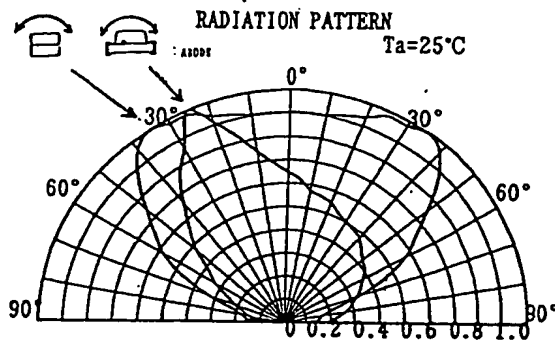
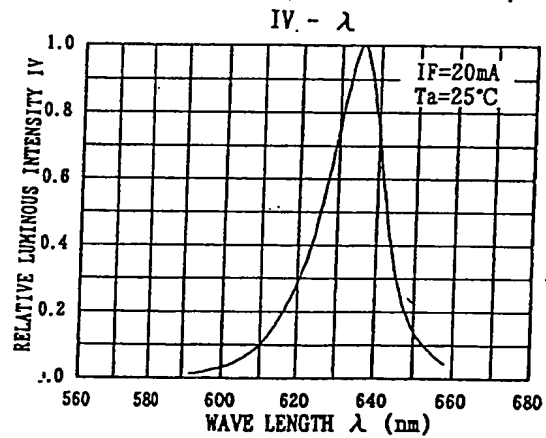
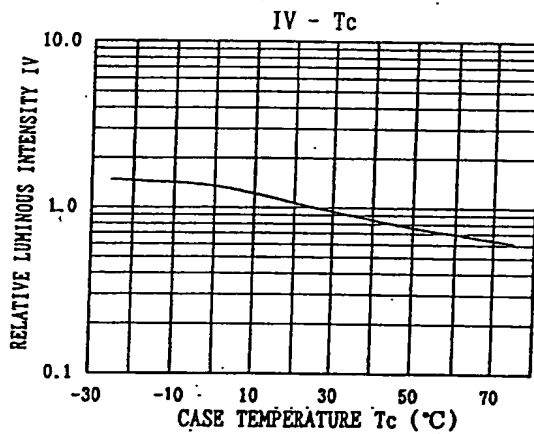
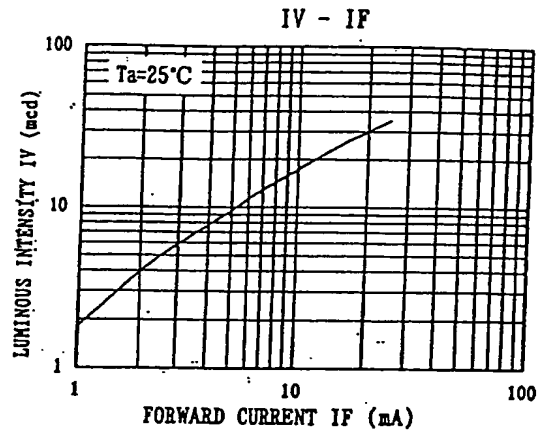
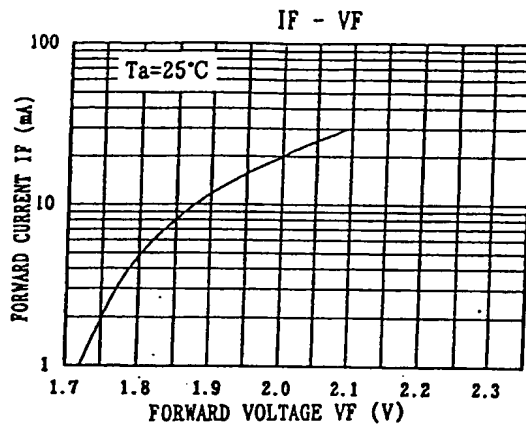


TOSHIBA CORPORATION

TOSHIBA SEMICONDUCTOR
TECHNICAL DATA

TLGU1002, TLOU1002, TLPGU100:
TLSU1002, TLYU1002

TLSU1002

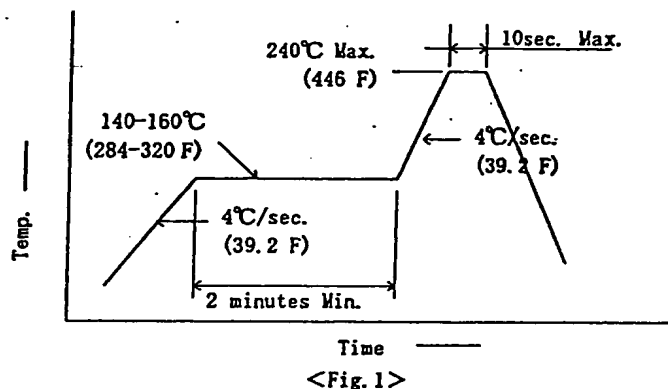


TOSHIBA CORPORATION

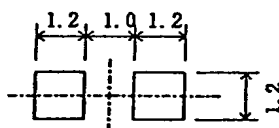
Soldering:

(1) Reflow soldering

- * It is recommended to use a reflow furnace of the upper and lower heater type.
- * The temperature profile as shown Fig.1 is recommended for soldering LEDs by the reflow furnace.



<Recommend soldering pattern>



Revision by manual soldering	: Soldering iron	Less than 25W
	Temperature	Lower than 300°C
	Time	Within 3 seconds

(2) Post solder cleaning:

When cleaning after soldering is needed, the following condition must be adhered to.

Cleaning solvents: AX225 or Alcohol

Temperature: 50°C (122° F) max. for 30 seconds or
30°C (86° F) max. for 3 minutes max.

Ultrasonic: 300W max.

PRECAUTION for MOUNTING

No force to plastic part of LED when LED is under high temperature.

No friction using a hard thing to avoid injuring plastic part of LED.

No contact between LED and the other parts, when install a assembled board into the set.

TOSHIBA CORPORATION

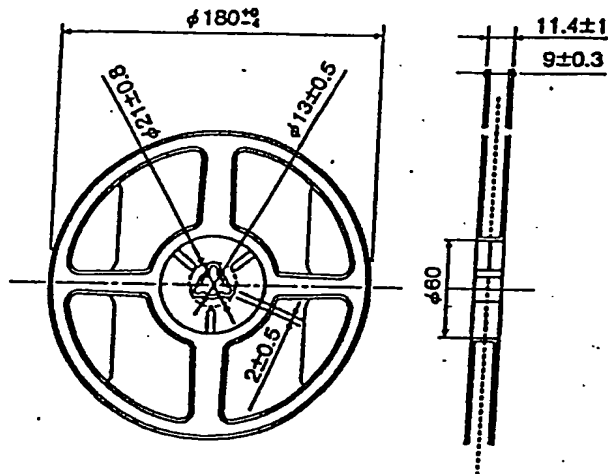
TOSHIBA SEMICONDUCTOR TECHNICAL DATA

TLGU1002, TLOU1002, TLPGU100
TLSU1002, TLYU1002

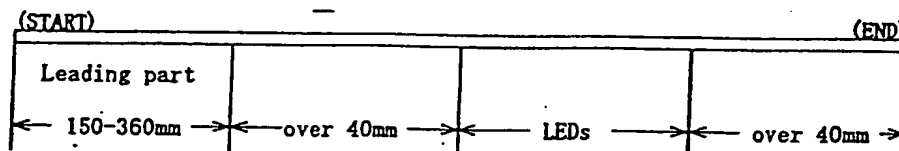
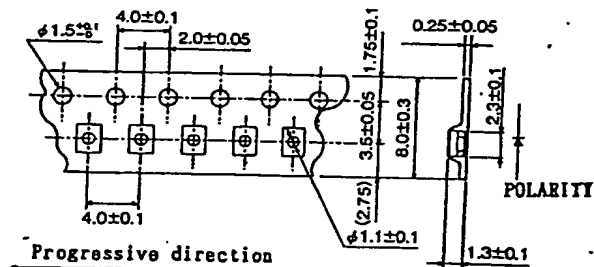
Taping specifications:

Unit:mm

Dimensions of reel



Dimensions of tape



Loaded quantity per reel : 3,000 PCS.

PACKAGING

LEDs are packed in ALUMINUM-envelope with silicagel to avoid the moisture absorption. After opening the package, Storing at following condition is recommended, since air extension at soldering according to the moisture absorption have influence on optical characteristics.

Temperature $5 \sim 30^{\circ}\text{C}$ Humidity 60%RH(max.)

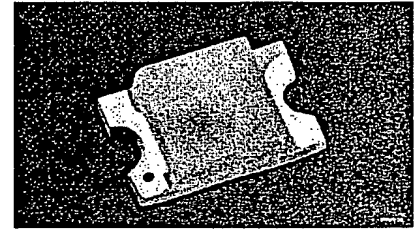
Please execute baking if it has been 6 months under packed or 1 week under opened.

Recommended baking condition: 60°C , over 12 hours

TOSHIBA CORPORATION

CHIPLED

LH R974



Besondere Merkmale

- **Gehäusotyp:** 0805
- **Besonderheit des Bauteils:** extrem kleine Bauform 2,0 mm x 1,25 mm x 0,8 mm
- **Wellenlänge:** 645 nm
- **Abstrahlwinkel:** extrem breite Abstrahlcharakteristik (160°)
- **Technologie:** GaAlAs
- **optischer Wirkungsgrad:** 3 lm/W
- **Verarbeitungsmethode:** für alle SMT-Bestücktechniken geeignet
- **Lötmethode:** IR Reflow Löten
- **Vorbehandlung:** nach JEDEC Level 2
- **Gurtung:** 8 mm Gurt mit 4000/Rolle, ø180 mm

Anwendungen

- optischer Indikator
- Statusanzeige
- Flache Hinterleuchtung (LCD, Handy, Schalter, Display)
- Markierungsbeleuchtung (z.B. Stufen, Fluchtwege, u.ä.)
- Spielsachen

Features

- **package:** 0805
- **feature of the device:** extremely small package 2.0 mm x 1.25 mm x 0.8 mm
- **wavelength:** 645 nm
- **viewing angle:** extremely wide (160°)
- **technology:** GaAlAs
- **optical efficiency:** 3 lm/W
- **assembly methods:** suitable for all SMT assembly methods
- **soldering methods:** IR reflow soldering
- **preconditioning:** acc. to JEDEC Level 2
- **taping:** 8 mm tape with 4000/reel, ø180 mm

Applications

- optical indicators
- status indication
- flat backlighting (LCD, cellular phones, switches, displays)
- marker lights (e.g. steps, exit ways, etc.)
- toys

Typ	Emissionsfarbe	Farbe der Lichtaustritts- fläche	Lichtstärke		Bestellnummer
Type	Color of Emission	Color of the Light Emitting Area	Luminous Intensity $I_F = 20 \text{ mA}$ $I_V \text{ (mcd)}$		Ordering Code
			min.	typ.	
LH R974	hyper-red	colorless diffused	11.2	15	Q62702-P5182

Helligkeitswerte werden mit einer Stromeinprägedauer von 25 ms und einer Genauigkeit von $\pm 11 \%$ ermittelt.
Luminous intensity is tested at a current pulse duration of 25 ms and a tolerance of $\pm 11 \%$.

Anm.: Die Standardlieferform von Serientypen beinhaltet alle Gruppen. Einzelne Gruppen sind nicht erhältlich.

In einer Verpackungseinheit / Gurt ist immer nur eine Gruppe enthalten.

Note: The standard shipping format for serial types includes all groups. Individual groups are not available.

No packing unit / tape ever contains more than one luminous intensity group.

Grenzwerte
Maximum Ratings

Bezeichnung Parameter	Symbol Symbol	Wert Value	Einheit Unit
Betriebstemperatur Operating temperature range	T_{op}	- 30 ... + 85	°C
Lagertemperatur Storage temperature range	T_{stg}	- 40 ... + 85	°C
Sperrschichttemperatur Junction temperature	T_j	+ 95	°C
Durchlassstrom Forward current	I_F	30	mA
Stoßstrom Surge current $t_p = 10 \mu s, D = 0.1$	I_{FM}	0.1	A
Sperrspannung Reverse voltage	V_R	5	V
Leistungsaufnahme Power consumption	P_{tot}	80	mW
Wärmewiderstand Thermal resistance Sperrschicht/Umgebung Junction/ambient	$R_{th JA}$	800	K/W
Sperrschicht/Lötpad Junction/solder point Montage auf PC-Board FR 4 (Padgröße $\geq 5 \text{ mm}^2$) mounted on PC board FR 4 (pad size $\geq 5 \text{ mm}^2$)	$R_{th JS}$	450	K/W

Kennwerte ($T_A = 25\text{ °C}$)

Characteristics

Bezeichnung Parameter	Symbol Symbol	Wert Value	Einheit Unit
Wellenlänge des emittierten Lichtes (typ.) Wavelength at peak emission $I_F = 20\text{ mA}$	λ_{peak}	660	nm
Dominantwellenlänge ¹⁾ (typ.) Dominant wavelength $I_F = 20\text{ mA}$	λ_{dom}	645	nm
Spektrale Bandbreite (typ.) Spectral bandwidth $I_F = 20\text{ mA}$	$\Delta\lambda$	20	nm
Abstrahlwinkel bei 50 % I_V (Vollwinkel) (typ.) Viewing angle at 50 % I_V	2ϕ	160	Grad deg.
Durchlassspannung ²⁾ (typ.) Forward voltage $I_F = 20\text{ mA}$	V_F (max.) V_F	1.8 2.6	V V
Sperrstrom (typ.) Reverse current $V_R = 5\text{ V}$	I_R (max.) I_R	0.02 100	μA μA
Temperaturkoeffizient von λ_{peak} (typ.) Temperature coefficient of λ_{peak} $I_F = 20\text{ mA}; -10\text{ °C} \leq T \leq 100\text{ °C}$	$TC_{\lambda_{\text{peak}}}$	0.18	nm/K
Temperaturkoeffizient von λ_{dom} (typ.) Temperature coefficient of λ_{dom} $I_F = 20\text{ mA}; -10\text{ °C} \leq T \leq 100\text{ °C}$	$TC_{\lambda_{\text{dom}}}$	0.06	nm/K
Temperaturkoeffizient von V_F (typ.) Temperature coefficient of V_F $I_F = 20\text{ mA}; -10\text{ °C} \leq T \leq 100\text{ °C}$	TC_V	-1.7	mV/K
Optischer Wirkungsgrad (typ.) Optical efficiency $I_F = 20\text{ mA}$	η_{opt}	3	lm/W

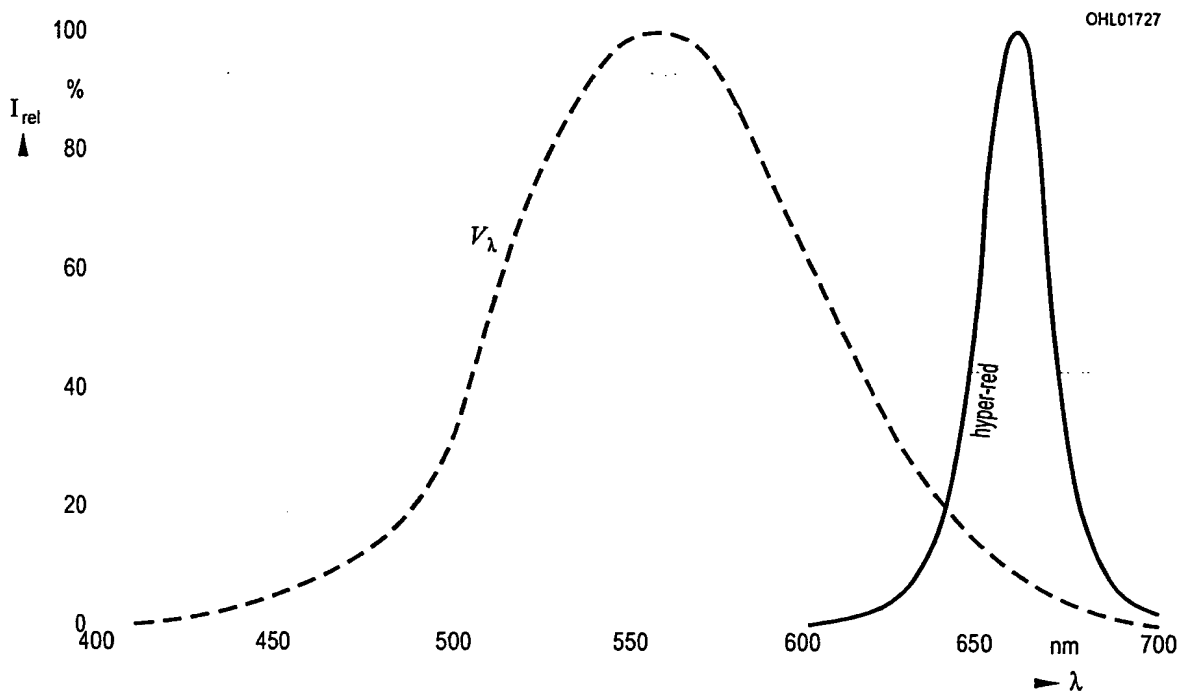
¹⁾ Wellenlängengruppen werden mit einer Stromeinprägedauer von 25 ms und einer Genauigkeit von $\pm 1\text{ nm}$ ermittelt.
Wavelength groups are tested at a current pulse duration of 25 ms and a tolerance of $\pm 1\text{ nm}$.

²⁾ Spannungswerte werden mit einer Stromeinprägedauer von 1 ms und einer Genauigkeit von $\pm 0,1\text{ V}$ ermittelt.
Voltages are tested at a current pulse duration of 1 ms and a tolerance of $\pm 0.1\text{ V}$.

Relative spektrale Emission $I_{\text{rel}} = f(\lambda)$, $T_A = 25^\circ\text{C}$, $I_F = 20\text{ mA}$

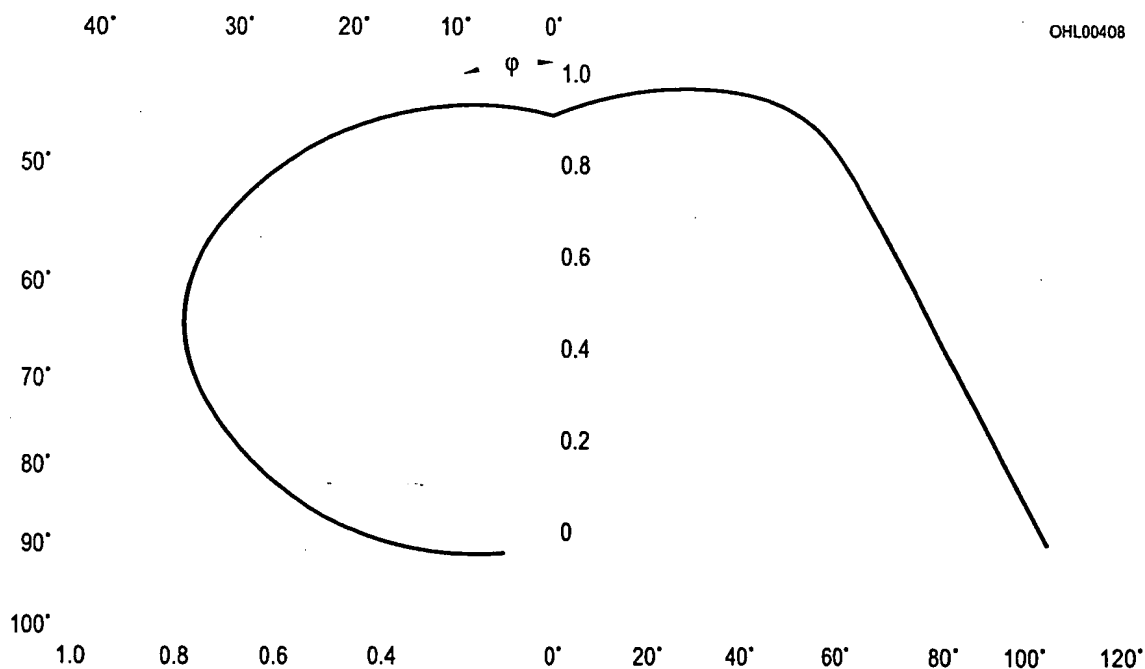
Relative Spectral Emission

$V(\lambda)$ = spektrale Augenempfindlichkeit
Standard eye response curve



Abstrahlcharakteristik $I_{\text{rel}} = f(\varphi)$

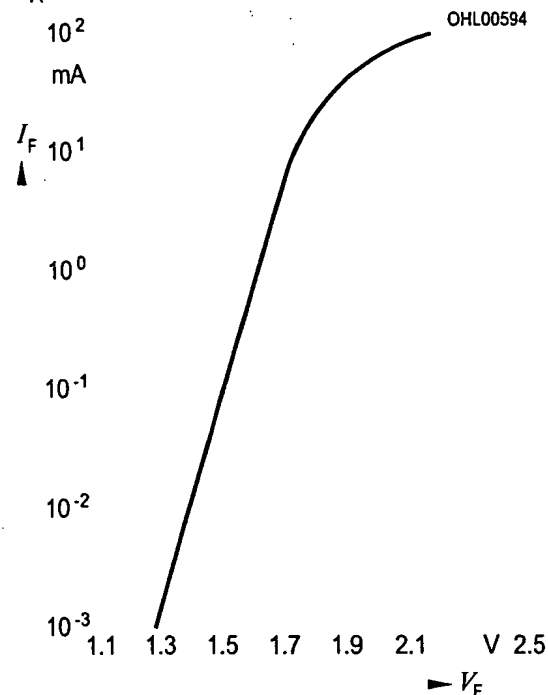
Radiation Characteristic



Durchlassstrom $I_F = f(V_F)$

Forward Current

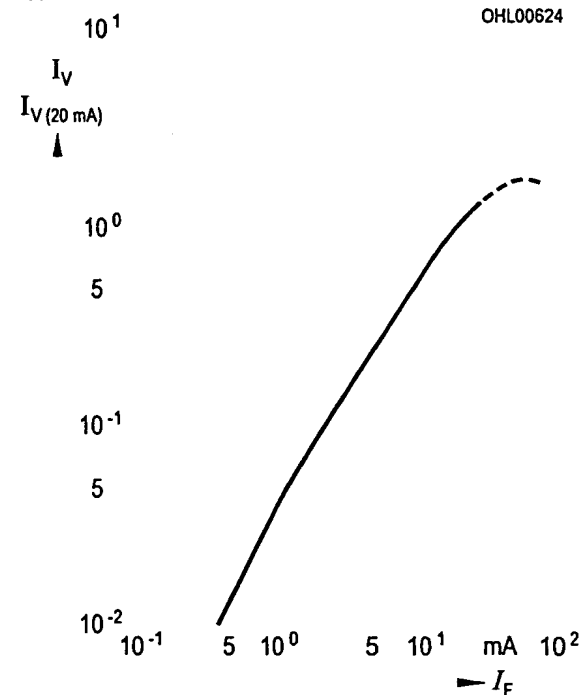
$T_A = 25^\circ\text{C}$



Relative Lichtstärke $I_V/I_{V(20\text{ mA})} = f(I_F)$

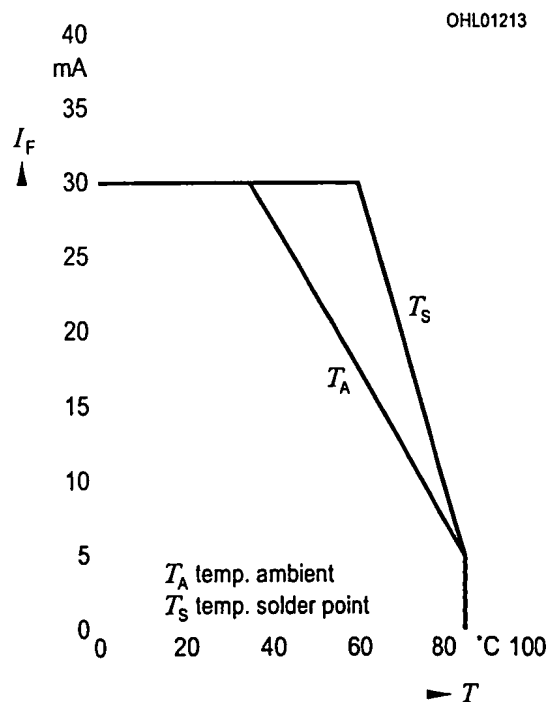
Relative Luminous Intensity

$T_A = 25^\circ\text{C}$



Maximal zulässiger Durchlassstrom $I_F = f(T)$

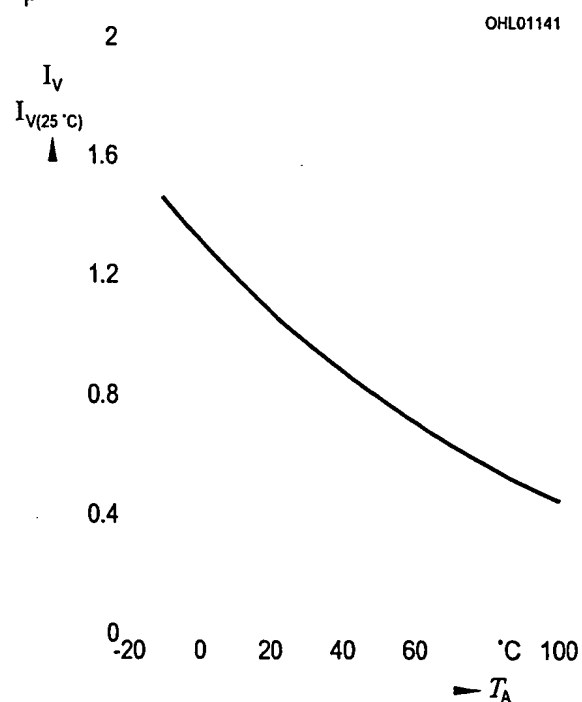
Max. Permissible Forward Current



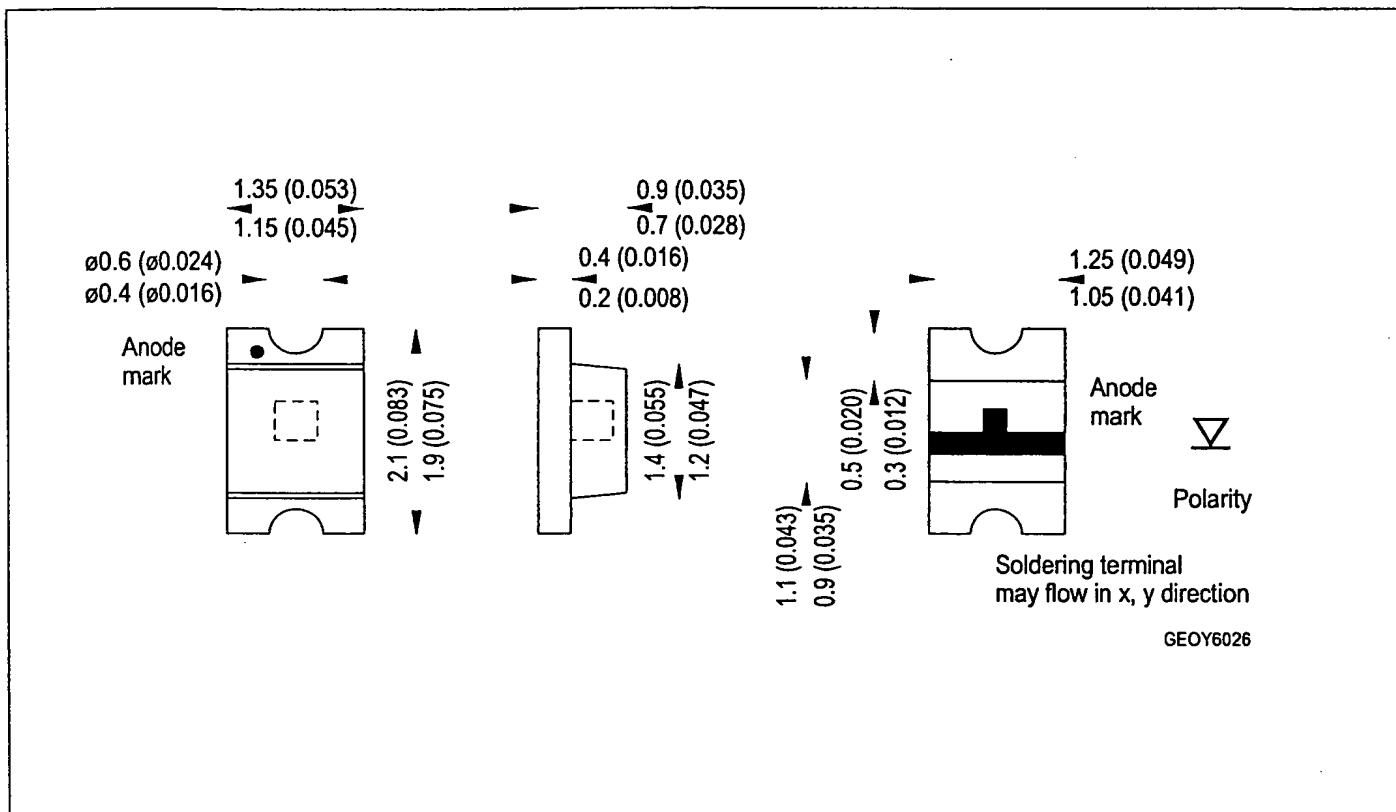
Relative Lichtstärke $I_V/I_{V(25^\circ\text{C})} = f(T_A)$

Relative Luminous Intensity

$I_F = 20\text{ mA}$



Maßzeichnung Package Outlines

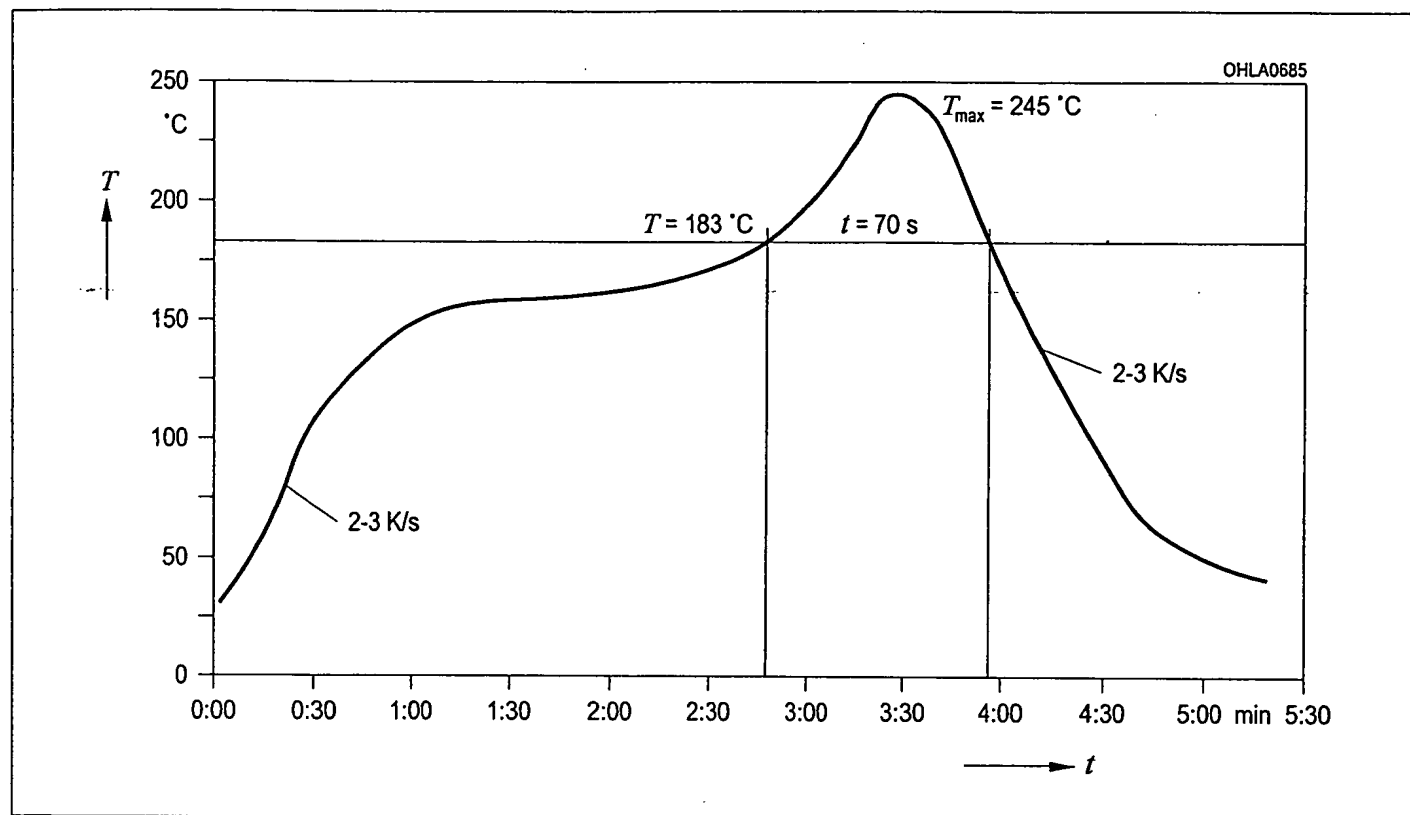


Maße werden wie folgt angegeben: mm (inch) / Dimensions are specified as follows: mm (inch).

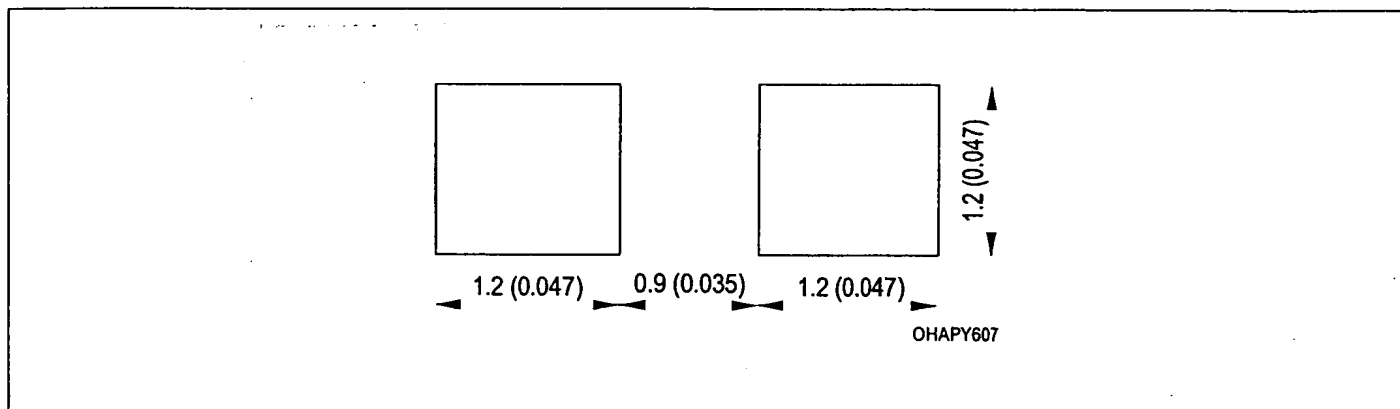
Gewicht / Approx. weight: 3.2 mg

Lötbedingungen Vorbehandlung nach JEDEC Level 2
Soldering Conditions Preconditioning acc. to JEDEC Level 2

IR-Reflow Lötprofil (nach IPC 9501)
IR Reflow Soldering Profile (acc. to IPC 9501)

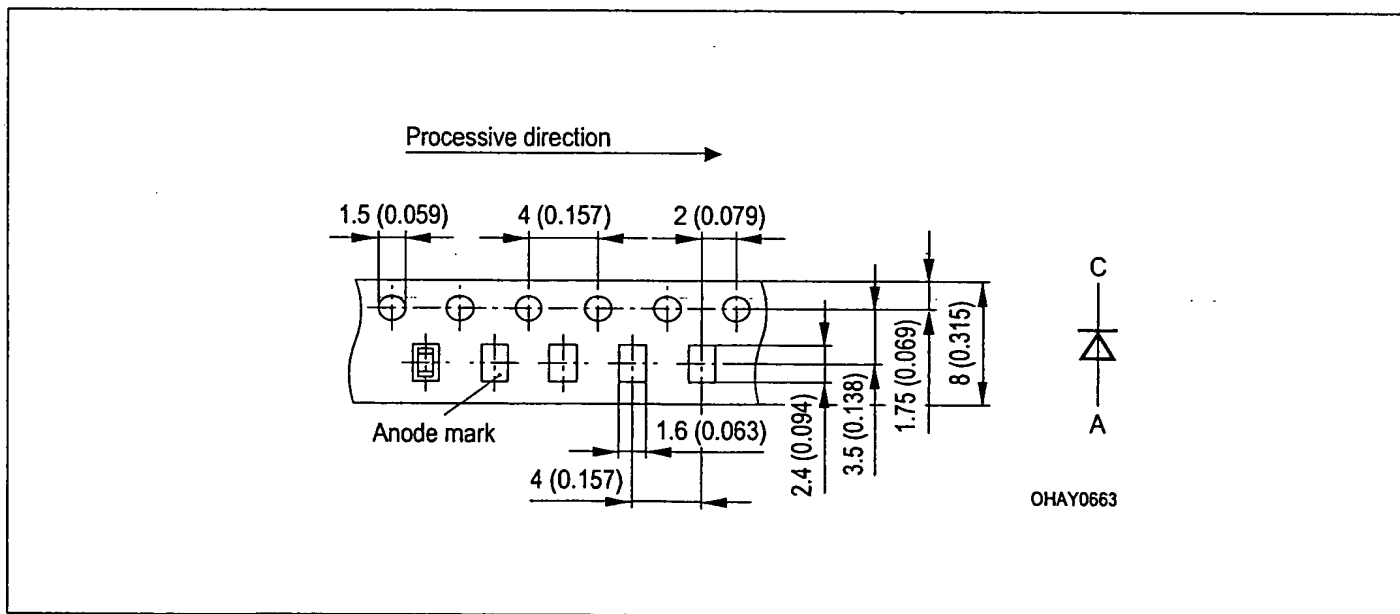


Empfohlenes Lötpaddesign IR Reflow Löten
Recommended Solder Pad IR Reflow Soldering



Maße werden wie folgt angegeben: mm (inch) / Dimensions are specified as follows: mm (inch).

Gurtung / Polarität und Lage Verpackungseinheit 4000/Rolle, ø180 mm
Method of Taping / Polarity and Orientation Packing unit 4000/reel, ø180 mm



Maße werden wie folgt angegeben: mm (inch) / Dimensions are specified as follows: mm (inch).

Revision History: 2002-04-11

Previous Version: 2002-03-13

Page	Subjects (major changes since last revision)
4	forward current
3	pad size from 16 mm ² to 5 mm ²

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Please use the recycling operators known to you. We can also help you – get in touch with your nearest sales office. By agreement we will take packing material back, if it is sorted. You must bear the costs of transport. For packing material that is returned to us unsorted or which we are not obliged to accept, we shall have to invoice you for any costs incurred.

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¹ A critical component is a component used in a life-support device or system whose failure can reasonably be expected to cause the failure of that life-support device or system, or to affect its safety or the effectiveness of that device or system.

² Life support devices or systems are intended (a) to be implanted in the human body, or (b) to support and/or maintain and sustain human life. If they fail, it is reasonable to assume that the health of the user may be endangered.

HOW TO MAKE A GOOD LAMINATED SAFETY GLASS FOR WINDSCREENS

Michel Van Russelt

Monsanto Chemicals Europe S.A.
Rue Laid Burnlat, B 1348 Louvain-La-Neuve, Belgium

ABSTRACT

This paper gives an overview of the complete manufacturing process from glass cutting and PVB cutting (and stretching) to the final inspection of windscreens before shipment.

Special attention should be paid to the processing conditions and their influence on the quality of laminated glass.

Each different de-airing process (nip roll, rubber ring and rubber bag) is reviewed and a range of recommended process conditions provided for each of them.

The last part of this paper concerns "in factory" testing to ensure that windscreens are of good quality both in terms of mechanical performance as well as ageing performance.

1. INTRODUCTION

The market for automotive laminated glass is growing regularly. Almost every new car in the world is now equipped with laminated safety glass and we see many new factories starting-up in different countries especially in the Asia Pacific area.

The process to manufacture automotive laminated safety glass is relatively complex as it involves glass bending technology as well as laminating technology. Being a major contributor to passenger safety, the laminated windscreen must satisfy a number of strict criteria not only in terms of optics but also in terms of mechanical performance and ageing characteristics.

After listing the main criteria for a windscreen, this paper will give an overview of the different steps involved in the manufacturing process with recommended conditions to achieve optimum characteristics of the windscreens. The aim of this process review is to give the manufacturer the opportunity to produce consistently windscreens of good quality at minimal cost.

The latter part of this paper will concentrate on recommended testing to be conducted within the factory to ensure conformity to standards.

2. PROCESS DESCRIPTION

The process flow diagram is divided in 4 main areas:

- glass preparation
- PVB preparation
- laminating process
- final inspection and testing

As one can see the real lamination occurs only in the 3rd step, but a lot of factors in sections 1 and 2 will play a role on the quality of the final product, reason why we really need to start from the basic raw materials glass and PVB.

Glass preparation:

glass storage
glass cutting
glass washing
glass bending
glass washing

PVB preparation:

PVB storage
stretching - cutting
relaxation

Laminating process:

assembly glass + PVB
de-airing
autoclaving

Final inspection and tests:

edge trimming
visual inspection
testing
packing and storage

3. QUALITY CRITERIA

Following criteria are considered:

- visual appearance: edge bubbles/defects
- optical distortion, light transmission
- mechanical performance: impact resistance (adhesion PVB - glass)
- ageing: stability of laminate with exposure to temperature and radiation.

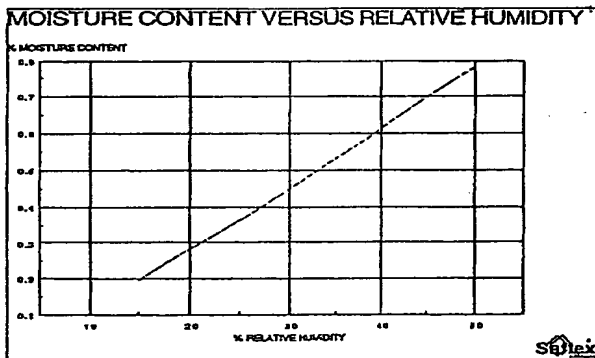
4. PVB CHARACTERISTICS

PVB characteristics influencing W/S quality

4.1. Moisture content:

PVB is hygroscopic and there is a relationship between the relative humidity in the ambient air and the moisture content at equilibrium in the PVB (see graph 1). It is recommended to operate between 0.4 and 0.65% moisture in the PVB.

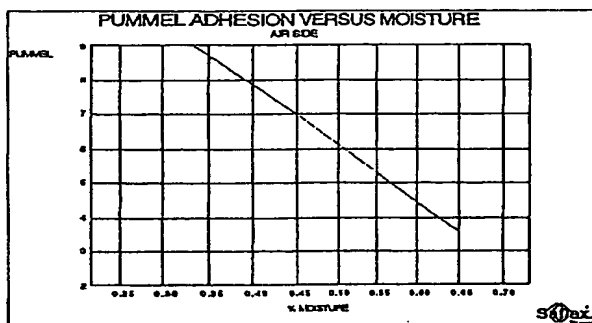
Excessive moisture in the PVB will have a dramatic effect on adhesion but could also induce defects in boil test and eventually milky haze (whitish aspect of the PVB) and delamination.



4.2. Adhesion to glass:

This is the most critical parameter as it controls the mechanical performance (Impact resistance of laminated glass). Factors influencing adhesion are:

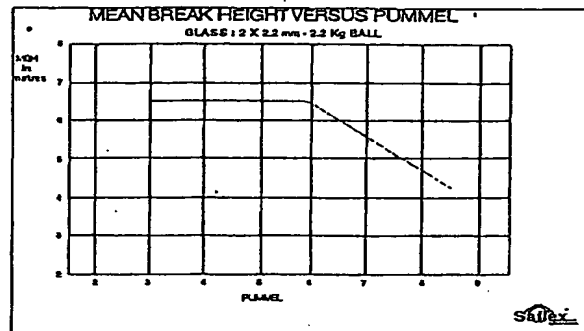
- glass surface and type
- glass characteristics
- PVB formulation
- PVB moisture content (see graph 2).



4.3. Mechanical performance:

Measured by Impact resistance in ball drop test. As shown in graph 3, impact resistance is controlled by adhesion of PVB to glass. It is therefore recommended to operate between 3 and 6 Pummel. PVB thickness is also an influencing factor, stretching will obviously reduce

thickness and therefore influence mechanical resistance of laminated glass.



5. DETAILS OF PROCESS STEPS

1. Glass preparation

1.1. Glass storage

In order to avoid hydrolysis of the glass surface, it is recommended to keep glass pieces separated by use of a parting agent (Lucite powder for example) and to keep it in dry conditions. It is recommended to mark the tin side of the float glass in order to laminate always with the same glass orientation as it might influence optics and adhesion to PVB.

1.2 Glass cutting

The use of good cutting tool (and lubricant) combined with edge grinding will result in a good edge finish.

1.3. Glass washing

This operation which follows the cutting process will eliminate all contaminants from the glass surface: oil, grease, finger prints, separating agent, dust, etc... The quality of the water used especially for the rinsing process might have an influence on adhesion of PVB to glass as any trace of salt left on the glass after drying will have a negative effect on adhesion especially if there is no other washing step after bending.

We do recommend to use demineralized water for rinsing, water conductivity should be 30 micro-Siemens/cm max. (ideally 10 micro-Siemens), water temperature around 40 to 60°C.

Good maintenance of the washing machine is key to have consistent quality.

1.4. Glass bending

In terms of windshield quality, the parallelism of both pieces of glass is critical to avoid glass

mismatch (bending defects) and bubbles after lamination. PVB will compensate very small variations but cannot fill a hole between both pieces of glass. We generally consider that 0.1 mm is the maximum difference allowable.

1.5. Glass washing

This would be the second and more critical washing step in the process (see 1.3). In some cases, people will not wash after bending and remove the parting agent (based on silica) by vacuum cleaning the glass pieces before assembly. Care should be taken not to leave any contaminant on the glass nor excessive amount of parting agent.

2. PVB preparation

2.1. PVB Storage

As the product is hygroscopic, it is important to ensure that packaging integrity has been maintained (especially the moisture proof bags used to protect the interlayer). Refrigerated interlayer will be kept below 10°C whilst interleaved can be stored at room temperature. There is no need for RH control in the storage area as long as the interlayer is kept within its original packaging.

2.2. PVB stretching - cutting

Stretching is optional but often used with a gradient colour band at the top of the windscreen as this process will allow the laminator to "tailor shape" the curvature of the gradient band to match the curvature of the roof line of the car.

The process has been described at length in another presentation; we will therefore not discuss it any further there.

As far as cutting is concerned, the operation is done at the end of the stretching process when there is one, otherwise, it would be done either manually or automatically (for large OEM operations PVB is unwound and cut automatically in trapezes to reduce waste).

The cut pieces (called blanks) are stacked up to 10-15 cm high representing a full roll 150-175 blanks and allowed to relax before assembly.

Typically we would recommend to unwind and cut the PVB at 18°C (± 5) for 16 hours before usage in a conditioned atmosphere 25 to 30% RH. Special attention should be paid to the cleanliness in this area as any dust particle would be attracted on the PVB surface by static electricity generated during unwinding. The cutting equipment should be grounded and usage of static bars or blowers is recommended.

3. Laminating process

3.1. Assembly

This is the process step where glass and PVB come together. Any contamination, any defect left either on the glass or on the PVB will be laminated and remain present in the final product. It is therefore critical to work in a clean environment. The table below summarises the recommended practice for the assembly room.

Room conditions:

- double door entrance (sas)
- over pressure in the room
- air filtration (dust free)
- special adhesive door mats to remove dust from shoe soles
- temperature: 18°C
- relative humidity: 25-30%
- limited passage
- special clothing: lint free + gloves and hair caps
- floor: tiles or special coating to allow easy cleaning

3.2. Lay-up conditions

Glass surface temperature should be between 25 and 30°C to allow easy positioning of PVB. If the temperature is higher there is a risk of PVB shrinkage, snap back or short vinyl in de-airing process and/or PVB undulation creating problems in the de-airing step. If the temperature is too low the glass pieces might slip during transport to the de-airing process and create glass mismatch.

PVB temperature should be 18°C; it should be laying flat with around 1 cm excess all around, trimming will reduce this to 1-2 mm from the edge without pulling the PVB.

3.3. De-airing

This is probably the most critical part of the whole process. The objectives of this steps are:

1. remove the maximum quantity of air trapped between PVB and glass
2. create preliminary adhesive bond glass/PVB before autoclave
3. edge seal to avoid air penetration during autoclaving.

The potential problems or defects resulting from a poor de-airing are:

- bubbles
- delamination
- poor thermal stability

There are three main types of de-airing processes:

- nip roll de-airing
- vacuum roll de-airing by rubber rings
by rubber bags

3.3.1. nip roll process:

This process generally uses 2 ovens and 2 sets of nip rollers. Key parameters to control are:

- pressure applied on the rollers
- temperature (glass and PVB)
- line speed

Temperature at exit of first oven should be between 40 and 60°C; the visual aspect of the windscreen should be uniform slightly greyish without traces of air pocket whilst the edges are still open (not transparent).

Conditions at the exit of the second oven will be different:

- glass temperature between 65 and 115°C
- visual aspect exiting the nip rollers should be clearer with a good overall edge seal and no traces of air pockets.

One should be careful with the use of clips after de-airing as those tend to create stresses locally on the windscreen which might result in thinning the PVB and lead to delamination later on.

Windscreens with black serigraphy along the periphery will require slightly different temperature conditions to ensure good edge seal.

3.3.2. vacuum de-airing:

Rather than forcing the air out of the laminate by applying pressure mechanically, the vacuum de-airing process will remove the entrapped air by applying vacuum in and around the windscreens. The process takes longer but generally results in a better de-airing quality, there are 2 different processes: rings and bags.

The key factors in the process are temperature and vacuum. It is indeed extremely important to remove the air whilst the laminate is still cold and later increase the temperature to seal the edges and ensure preliminary adhesion. As the air is being removed from the periphery, any premature edge seal will block the remaining air in the laminate and result in large air pockets and eventually bubbles.

The recommended temperature range for the first step of the process is 20 to 30°C with a minimum vacuum time of 5 minutes before heating.

The vacuum level should be from 0.6 to 0.8 bar and maintained during the whole process.

The temperature of the bags and the rubber rings is obviously critical as this will influence the risk of premature edge seal.

a) Rubber ring process

This is a manual operation by which an operator will install a rubber ring around the windscreen and then connect it to a main vacuum line. The windscreen will then progressively be heated as it moves into an air circulation oven, the maximum glass temperature is around 90°C. When the glass exits the oven the vacuum is disconnected and the rubber ring removed. The windscreen is almost transparent.

Advantages:

- not expensive
- accommodates all windscreen shapes
- excellent de-airing

Disadvantages:

- speed (slow process)
- requires different sizes of rubber rings depending on W/S types
- labour intensive.

b) Vacuum bag process

This is a fully automated process in which the windscreen is automatically loaded into the bag which then closed and is connected to a vacuum pump. The bags move into an air circulating oven where it will reach a temperature of 110-120°C (W/S temp. 100°C). At the end of the oven, the bag will be disconnected from the vacuum line, opened automatically and the windscreen is taken out of the bag by a robot.

This system is used for extensive OEM production series.

Advantages:

- large series
- speed

Disadvantages:

- cost (mainly maintenance cost).

3.4. Autoclaving

During the autoclave process, the remaining air existing in the sandwich will be dissolved in the interlayer and, at the same time, the interlayer will flow within all glass surface micro cracks and fill the gap between the pieces of glass.

After this step, the laminated glass is completely transparent and offers its final performance characteristics.

The recommended operating conditions are listed below:

- load the autoclave shortly after de-airing (less than 12 hours)
- pressure and temperature should increase simultaneously
- recommended temperature: 130-150°C

- recommended pressure: 12-15 bar
- hold time at maximum pressure and temperature: minimum 20 minutes (will depend on autoclave type and air circulation flow within the autoclave).

It is very important to maintain the pressure during the cooling step until the glass temperature has reached 50°C maximum. Failing to do so would create a series of small bubbles around the edge of the laminated windscreen.

4. Final inspection and testing

4.1. Edge trimming and visual aspect

Those operations are done simultaneously after autoclaving. Each windscreen passes thru an inspection station in which an intensive light beam is projected thru the windscreen. Inspectors will check the overall appearance as well as any objectionable defect: contamination, glass scratches, edge bubbles etc... Those windscreens will be either rejected or sent for repair or re-autoclaving. All others will be treated for edge trimming, - operation by which one trims the excess PVB around the edge of the laminate - and then packed in crates for shipping.

4.2. Testing

As discussed in the section 3 "Quality Criteria", one needs to ensure that windscreens satisfy visual, mechanical performance and ageing criteria. Those tests are done in the Quality Control Laboratory by selecting randomly a few windscreens out of the daily production.

We would recommend to do the following tests:

- visual inspection - optical distortion
- adhesion testing
- impact testing
- boil and bake tests.

4.2.1. Optical testing:

Aside from the visual inspection done in production, windscreens should be tested for optical distortion according to national or international standards, to ensure that there would be no distortion of the view of the driver or its passenger. A slide projector is used to project a special image thru the windscreen on a grid board. Any optical distortion would appear as a deformation of the image on the grid board. Main causes for optical distortions are glass bending defects or glass particles left in the laminates which will cause a lens effect.

4.2.2. Adhesion testing:

The most widely used adhesion test done so far is the Pummel test by which a piece of glass

cut from a windscreen has been conditioned for a minimum of 2 hours at -20°C and then pummelled with a hammer. The amount of glass particles still adhering to the interlayer is then compared to a set of standards, the recommended range is from 3 to 6 Pummel to ensure good windscreen performances.

4.2.3. Impact:

This test is specified in the standards. One drops a steel ball of 2.26 kg from a height of 4m on samples 30x30 cm square cut from windscreens. The glass might break but the ball should not pass thru during impact. As indicated above when the adhesion level is within 3 to 6 Pummel, one should pass the test without any problem.

4.2.4. Boil test:

This is also specified in the standards. A piece of laminated glass cut from the windscreen is being put for 2 hours in boiling water. After this test, a whitening of the interlayer is allowed around the edge but no bubbles nor any other defects are allowed in the laminate.

4.2.5. Bake test:

Although not official, we often test windscreen stability by use of a bake test during which we would submit windscreen samples to heat in an oven (16 hours at 100°C, followed by one hour each time 10 degrees higher until first bubbles appear). This test is a good prediction of the de-airing quality and stability in hot climates. The minimum temperature for bubble appearance should be 130°C.

CONCLUSIONS

We have reviewed here the main steps of the manufacturing process for automotive laminated glass. If one follows our recommendations and pays attention to the critical steps and advises given in this paper, one could reasonably expect to make excellent quality products contributing to the overall safety of the passengers of automotive vehicles.

XII. RELATED PROCEEDINGS APPENDIX
